Concrete

Vol. 20 *Detroit, February, 1922* *No. 2*

62 Million Square Yards

IT is a peculiar thing about many achievements in the field of construction that somebody first does a job in a new way—like building a road out of concrete—and it is a good job and a lot of people who object to thinking along new lines immediately say: "It can't be—this will never do." Then a few, seeing, begin to believe, and then in a little while—a dozen years—it is a contagion.

Sixty-two million square yards of concrete pavement were put down in the United States in 1921—a 74% increase over 1920, the previous high record. The amount of resistance, of human inertia, of stand-pat allegiance to things as they *have* been, that any new thing has to overcome, is prodigious, *wasted effort.* But it *wasn't* wasted. The true worth of a new thing is best measured by the amount of resistance it has overcome. Developing the concrete road against resistance has developed a better concrete road. And in that process (after establishing a record of sixty-two million square yards in 1921) there is under way a program of research that may tell us *how* to build them.

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Block vs. Tile

ONE of the things which the American Concrete Institute will have up for discussion at its convention in Cleveland (February 13 to 16) is the relative status of concrete block and concrete building tile. There has developed a strong opposition to the adoption of new standards tentatively offered by the Institute's Committee P-1, Standard Concrete Building Units.

Stripped of all fine distinction and technical hair-splitting, the nub of the controversy appears to be just this:

Mr. Building Tile is a newcomer and wants to live *under the law* on the same street with Mr. Block. Mr. Block is a "climber," but hasn't got very high (usually not above cellar windows), and is afraid to associate in close accord with Mr. B. T., for fear it will be damaging to himself.

Joking aside: a concrete block is a good unit (when it is good), and so is a concrete tile. The block is heavy and will stand a bigger load (quality being equal) than a tile. Also, it takes more concrete to make a block, and two hands to lay it. A tile is thinner webbed, is usually picked up and set in place with the mason's one hand while the trowel is wielded uninterruptedly in the other.

A concrete tile has important work to do. It has a definite place. As a base for stucco, for curtain walls, for ordinary residence construction, for partitions, as a back-up unit, it has big possibilities. It has established itself in Detroit, Mich., for instance, against heavy odds. It will probably oust heavy common block in many of its present uses. If it does, it will be because it is better for the purpose. Face block will not feel that competition. It is in a different field. If it does nothing else, it will force the making of better block by driving it more and more into a new field. There is no reason why all concrete building units, no matter for what *use,* should be made to pass the same tests.

Then there is cinder block edging into the circle of dispute. It can't pass the absorption test, nor the strength test, which a unit for exterior facing or for heavy work should be obliged to pass. The chief value of cinder block is inherent in its *inability* to pass these tests. The cinder block is extremely porous. It's popcorn ball characteristics make it a good insulator. With a seal coat of waterproof stucco on the outside, it makes a good wall. It must be strong enough. To try to make it much stronger takes from rather than adds to its value.

This magazine has always stood for high standards. It still does. It believes that a standard high enough for a unit designed for certain uses is too absurdly high for other units intended for other uses.

Let's draw our standards so as to get the economic value of all our assets in the field, not just part of them, at the expense and to the limitation of the others.

* * *

Two Reasons

THERE are two reasons for not being a member of the American Concrete Institute:

(1) Lack of direct interest in the study of the best way to do things with concrete;

(2) Lack of ten dollars a year for dues.

We mention this because the Institute is engaged in a membership drive. It has doubled its membership in two years—from 383 to about 800. It wants to have a thousand members at the time of its convention in Cleveland, February 13 to 16. It wants this additional membership strength for two reasons: to increase its income and to have the help of the members on committees and otherwise in solving a lot of problems which beset the fellows, in the Institute and out, who are designing, manufacturing and building with concrete. Solving these problems raises the standards under which all of us work. When we raise our standards and sustain them, we raise ourselves. The address of the Secretary of the Institute is 314 New Telegraph Building, Detroit, Mich.

The Institute's convention program (February 13-16), described in detail last month, is skeletonized as follows:

Monday—2 p. m., Roads; 8 p. m., Houses.

Tuesday—9 a. m., Research; 2 p. m. and 8 p. m., Concrete Products.

Wednesday—9 a. m. and 2 p. m., Field Problems of Contractors; 9 p. m., A Social Get-Together.

Thursday—9 a. m. and 2 p. m., Engineering Design.

IT was planned to use this page for an editorial message to the products field. The receipt of the letter from Mr. Raymond upset the plan. What our correspondent says has the fresh eloquence that is inspired by direct contact with a deplorable situation.—Editor.

". . . for of the abundance of the heart his mouth speaketh."

—Luke 6:45.

Mt. Clemens, Mich., Jan. 16, 1922.

AS I have suspended operations in my plant until conditions are different, please cancel my subscription to Concrete until further notice.

I cannot make blocks to compete with the cheap product others here manufacture.

Until I can get an ordinance passed compelling all makers of blocks, etc., to make a standard product that will pass a test, and until an ordinance is passed requiring a test of concrete products, I do not intend to make any blocks.

I have shipped several jobs to Detroit, and my blocks passed the test, but the most of the rummies around here buy the cheap stuff, because they think they are saving a couple of cents, then put up a "holler" when they find out they are "stung." As it costs me as much to make my blocks as some of the others sell them for, you can see that I would not last if I could not make a profit. My blocks remain in the yard because these boneheads around here can't see why I should charge a couple of cents more for a block that you can hit with a hammer and have it ring like a bell, than the others charge for blocks made with a teaspoonful of cement to a yard of gravel, that you can crumble with your fingers. They look at the price and not the quality. This shows very plainly that the majority of the people buying blocks have nothing above the ears but hair and scalp disease.

I have been disgusted with the business for some time. It makes a man disgusted to have people come to your yard, show them an A-No. 1 product, give them a fair price, then have seven out of ten tell you that they can get blocks from others for two or three cents cheaper; go there and place their order, then hear them yell when their foundation is laid and their yard filled with a bunch of broken blocks laying around; but the fact remains that the other people got the order, and the money, and I still have blocks on hand. I have been tempted several times to make a blame cheap product and let the dam fools have the same cheap stuff the others make at the same price, as they seem to want to get stung; then I take another thought that it would ruin the future of the business, and I will make a good product or none. I like your journal, and if I start operations again I will renew my subscription. If not, I will take up another line of business.

Very truly yours,

A. L. Raymond.

Outstanding Ideas Influencing Concrete Road Building

A Symposium, with Discussions by

CLIFFORD OLDER, A. T. GOLDBECK, T. R. AGG, N. F. HELMERS, H. J. KUELLING, H. V. GOODRICH, W. F. REICHARDT, R. F. HILL, H. S. VAN SCOYOC

Followed by a Review of Concrete Road Building in 1921

Industrial Railway and Truck Delivery—Central Plants—Night Shifts—Research

BY CLIFFORD OLDER
CHIEF HIGHWAY ENGINEER, DIVISION OF HIGHWAYS
SPRINGFIELD, ILL.

In Illinois no radical changes in construction methods were adopted in 1921.

Industrial railway delivery of materials continues to be popular, especially where the road under construction does not involve grades over 2% or 3%. Truck delivery of materials, however, seems to be equally popular. Where truck delivery is practiced, there is an increasing number of contractors using two, two and one-half and three-ton trucks, equipped with pneumatic tires.

Both central mixing and central proportioning plants are used with success. Perhaps the most outstanding development is the use of night shifts by several of our contractors, for a good part of the season. This has met with complete success. One contractor, who used a night shift about one-half of the season, succeeded in laying about 16 miles of 16-ft. concrete pavement with one four-bag batch mixer.

A resume of the year's progress in highway construction would not be complete without reference to the fact that research work which has been undertaken by various highway departments and the U. S. Office of Public Roads indicates quite clearly that, given a knowledge of load limitations and subgrade conditions, pavements may be designed with a reasonable degree of certainty as to their service value.

Research

BY A. T. GOLDBECK
CHIEF, DIVISION OF TESTS
U. S. BUREAU OF PUBLIC ROADS

During no other year has there been so much research activity in connection with concrete roads as during the year just passed. Road engineers are just awakening to the fact that there must be certain underlying principles applicable to the design of concrete roads, as well as to the design of other concrete structures, and the necessity for the most economical designs to suit the various conditions has led to increased research efforts to establish these underlying principles.

The splendid service tests on reinforced concrete and plain concrete sections being conducted at Pittsburg, California, and through investigations under way on the Bates road by the Illinois Division of Highways, together with the investigations by the Bureau of Public Roads, will go far in shedding light on moot questions in the design of concrete roads. These investigations are accomplishing much in bringing to the minds of engineers the desirability of a much closer study of the practical conditions to be met and a more thorough analysis of the designs necessary to meet those conditions.

Relocations—Research

BY T. R. AGG
PROFESSOR HIGHWAY ENGINEERING
IOWA STATE COLLEGE, AMES, IOWA

One significant development in the highway field in the last year has been the very great advance in the practice relative to re-design of roads for improvement. For a long time engineers felt great hesitancy in departing from the old-established right of way lines of the roads that were to be improved. Relocations were undertaken only when especially dangerous places or where particularly rough topography was encountered. Now the relocation of ten miles or more of highway is not at all uncommon and longer relocations or the laying out of an entirely new road is undertaken without great hesitation, if conditions seem to warrant.

Along with the advance in the practice relative to alignment has gone a gradual betterment in the design of such details as curves, gutter sections and pavement cross-sections.

Another significant development has been in the field of highway research. While no adequate research program has been undertaken in the highway field, there has come a general recognition of the need for such research. Agencies have been established that have for their purpose the stimulation of highway research, and the highway engineer can look forward hopefully to the time when there will be available to him much of the fundamental data necessary for economical highway improvement.

Wet Mix Hauling Cost—Industrial Railway

BY N. F. HELMERS
SIEMS, HELMERS & SCHAFFNER, CONTRACTORS
ST. PAUL, MINN.

We are interested in concrete road building only from the standpoint of the constructor. To the writer's mind one of the outstanding features in road building has been the increasing use of the central plant and wet batch haul. This has in a large measure been due to the fact that truck men in general have been quoting very low prices on all sorts of haulage, and in many cases have not appreciated the additional weight involved in the wet batch haul. Indications in this territory are that the truck men are now waking up to the fact that past prices have not been based on the proper analysis of their costs, and with the possible increase in the cost of such haulage the central mixing plant may lose some of its enthusiastic supporters.

This situation has been instrumental in relegating the use of the industrial track to the scrap heap, thus depriving the various highway departments of the one method which gives them an absolutely true subgrade, always open to inspection, and a subgrade of *uniform compactness.* I would lay particular stress on the latter feature, inasmuch as any form of truck haul, whether dry batch or wet batch, in addition to other objections, creates a compact road rut under the center of the slab. It is obvious that this feature, under certain conditions, can easily introduce a central longitudinal crack.

In many cases where concrete paving has been done by truck haul, aggregate has been brought in on adjoining roads which have been so badly cut up by such truck hauling as to necessitate regraveling and other heavy repairs. Had the work been done by the industrial track method this extra expense would not have been incurred, and had such expense been added to the truck haul bid, it would have been far in excess of any industrial track proposal. In other words, we believe that in the scramble for lower prices on concrete road work, the superior method has been side-tracked, and unfairly so.

Construction Joints—Center Joints—Reinforcement — Small Plants

By H. J. Kuelling
Construction Engineer
Wisconsin Highway Commission
Madison, Wis.

In the matter of construction joints: we are convinced that the time of the year when the road is constructed has some bearing on the matter. It has been determined to leave out all the joints in the highways to be constructed during July and August of next year. We believe that concrete built during the summer is much less liable to expand than that built either earlier or later in the season.

We are going to try out ten or twenty miles with a center joint, largely with the idea that it will act as a divider of traffic, as we are still to be convinced of the necessity of splitting a road in two merely to prevent cracking, when a large share of the roads do not crack longitudinally.

Regarding reinforcement: We will continue to reinforce transversely with approximately ½-in. rods, spaced 4 ft. or 5 ft. apart. The length of these rods will be about three-fourths of the width of the road. They will be staggered so that the center of the pavement will have more reinforcement than the edges. This reinforcement will be placed in wet cuts, as it has been our custom in the past couple of years, and also in fills where there is an old core which has been widened.

For longitudinal reinforcement we are going to try ten to twenty miles with one heavy rod on each outer edge to reinforce against breakage by heavy truck hauling. Because of the reasonably small amount of breaking of corners that we have had, we somewhat doubt the economy of adopting a 100% longitudinal reinforcement along the edges.

Regarding proportions: We expect to make some rather radical changes. The sands in Wisconsin vary from some that about equal standard Ottawa strength to others as high as 180%, or higher than the standard Ottawa strength. Obviously it is not fair to use the same mortar with all these sands as we and the other states have been doing. We therefore expect to vary the proportion of our mixture somewhat in accordance with the strength attained by the sand mortars. In other words, we know we are getting out better concrete with the very high grade sands than we are with the ordinary sands. Whether or not we will try to make the low grade sands into a richer mortar or whether we will lighten up a little on the cement content with the better sands we have not decided.

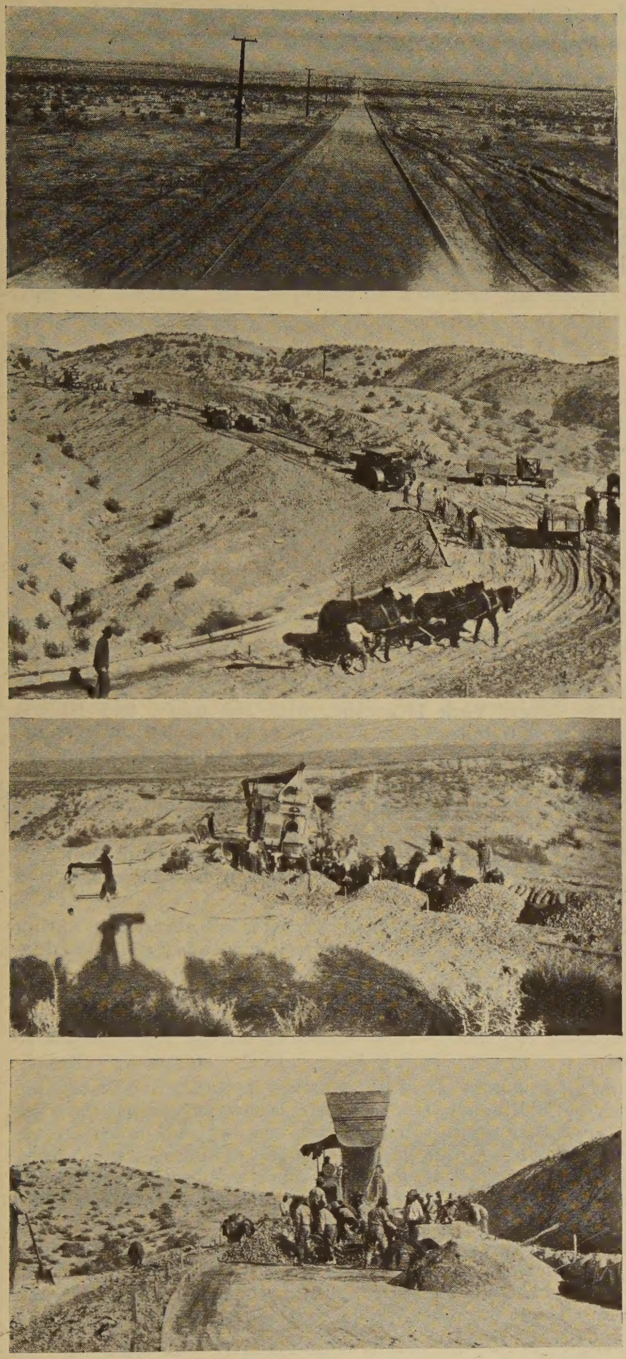
Regarding central mixing plants: We do not desire to see any more of them in our state. We have very few of them, and in most cases they have been unsatisfactory. We believe we can get a better concrete of more uniform texture by mixing the material on the road.

One thing on which we do not agree with some of our neighbors is the placing of material on the subgrade. We by no means will bar the use of the old wheelbarrow method of constructing pavements from materials previously placed on the subgrade. We believe that with regular inspection, such as concrete roads are supposed to get, the amount of material that will get into the surface from the subgrade will be a very minor quantity. In fact, in our past years' experiences we have had very little trouble from this source. We have had occasional jobs where some subgrade material did get into the mixture, but on the other hand we have also had a considerable number of jobs where material from the bottom of stock piles and out of cars and from other sources also got into the concrete.

There is undoubtedly a little more material wasted by dumping on the subgrade, but at the prices we pay in Wisconsin we do not think this is as serious a proposition as adding more cost to the pavement in more expensive methods. We believe with the present labor market and the present price of materials, we can build roads cheaper for the public with the old wheelbarrow method than we can in many cases with the more expensive equipment. We have carried on several day labor operations the past season, and have observed many of our contractors, and we still believe that there will be a large number of wheelbarrow outfits run in 1922 and in future years.

We believe there is an economic limit in the construction of concrete roads. It is somewhat like building a house; the better the house, the better we like it. But sometimes the better the house, the more our pocketbook suffers. So it is with the concrete roads. We must choose the roads that will be reasonably satisfactory to the traveling public, and not go too far beyond that in refinement. There is no doubt that heavy reinforcement, thicker roads, wider roads, higher priced materials, etc., would make better concrete highways. Whether or not we are justified in adopting these is a very great economic question. We believe our roads in Wisconsin are giving fairly good satisfaction, and we are attempting to hold them down to an economic basis.

Regarding finishing machines: Most of our engineers are dissatisfied with their use, especially where joints are being placed in the road or where the road is on a grade of more than 4%. While we will not bar the finishing machines for the coming season, we will not encourage them. Our reason for not barring them is that we believe a machine may be invented which is not detrimental to the riding qualities of the road, and we would not care to bar one that would give good satisfaction.



Figs. 1-4—(Top to Bottom) Building Concrete Road in Desert Regions of California, Where Water Was Pumped Seven Miles

Quality *vs.* Speed

By W. F. Reichardt
Consulting Municipal Engineer
Watertown, Wis.

The only change the writer has made in his specifications and design of reinforced concrete pavements consists of an increase in the amount of reinforcing material used.

The writer is of the opinion that road builders are apt to sacrifice quality for speed, and he has seen some road constructed where speed appeared to be the essential element.

It is far better to delay the opening of a road a few weeks, if in the end the road has been properly constructed, for the pavement is expected to last many years, and the few extra weeks required in construction is well worth while. The writer believes the average contractor will do well to work for a proper mix, in preference to attaining fame in his locality for speed. We have all heard that "haste makes waste," and this is now true on some contracts for the construction of concrete roads.

Desert Concreting

By H. V. Goodrich
Rogers Brothers Co.
Los Angeles, Cal.

The four illustrations from photographs of concrete road construction in the west side of Kern county, California, give an idea of the desert conditions which necessitated the use of seven miles of 3 in. water line on a recent job.

Fig. 1 shows a long stretch of subgrade prepared with over a half-mile of material on the grade and the mixer in the dim distance, this being possible in a fairly level country where a side road could be used for hauling.

Fig. 2 shows a portion of this road, extending about two miles through the hills—6% grade and superelevated curves. The road is 20 ft. wide, 7 in. thick, 1:2:4 concrete. In this picture the mixer is seen in operation, the trucks are delivering materials (sand, gravel and cement), and the subgrade gang is working—all within a distance of about 2,000 ft., the rough grade having been done previously. It was necessary to carry on the work in this way through the hills, as it was impossible to have side roads or detours for getting the material in. Still we were able to balance the outfit so that the mixer, a 21-E Foote, turned out an average of more than 225 cu. yds. of concrete per day, over a period of 20 days.

Fig. 3, taken from the top of the hills, gives an idea of the country.

Fig. 4 shows the condition of the subgrade just ahead of the mixer, and we think it was kept in very good condition, notwithstanding the crowded conditions under which the work was carried on.

Economy of Large Plant

By R. F. Hill
Vice-Pres., A. J. Smith Construction Co.
Detroit

We completed last season about 20 miles of concrete paving, using 14E and 21E pavers, and the results from the work of each outfit has established our belief in the economy of the larger units. There are many fixed costs which go to make up the unit cost of paving and naturally when the daily yardage is increased the unit price decreases. Therefore, in order to keep the unit prices down there must be a large daily production and enough work to keep equipment busy for the full working season, or approximately six months in this part of the country.

While many engineers have expressed a preference for letting the work in smaller units, we are sure that if the work in the future is to be attractive to contractors who keep a permanent organization for such work and a quantity of modern road building equipment, contracts must cover sufficient mileage to warrant the use of large units where production in square yards of pavement can be maintained for the full season.

This, we believe will be the answer in obtaining lowest unit costs, which are to be desired by everyone so that the large programs for concrete highways can be carried out as economically as possible.

Longitudinal Joints — Labor Saving

By H. S. Van Scoyoc
Manager of Publicity, Canada Cement Co., Ltd.
Montreal

One of the outstanding features in 1921 concrete road construction was an increasing tendency to build pavement 16 ft. or more wide in two slabs. There is also an increase of appreciation that where reinforcing is felt to be necessary, it should be of such form and of such weight as really to take care of the difficulties that seem to make its use desirable.

There was also a decided tendency to consider more seriously than has been the case for the last several years the economic side of labor saving plant installations. The great improvements in labor conditions have undoubtedly made a careful consideration of the relation between hand labor and machine labor necessary, if the greatest economy in construction costs were to be realized.

Concrete Roads in 1921—A Review

74% More Roads in 1921 Than in 1920

Prepared in Co-operation with C. R. Ege
Manager Highway Bureau, Portland Cement Association

New awards for concrete pavements in 1921 totaled 56,181,000 sq. yds., breaking all previous records.

More than 62,000,000 sq. yds. were actually built in 1921—74% more than in 1920, the best previous year. This indicates the way the builders are responding to increased demand with vastly increased output.

The year 1921 may go down in history as having been made to order for highway engineers, says the *Concrete Highway Magazine* of the Portland Cement Association. The preceding winter was short and mild in most sections of the country. Spring "opened" early. Approximately 30,000,000 sq. yds. of concrete pavement were under contract, carried over from 1920. Contractors who had uncompleted jobs were able to take advantage of the first hint of mild winter. Many state and county officials advertised all of their 1921 work during the winter and early months of the year. More work, in large volume, was offered throughout 1921, but it was the "early awards" and the hold-over work that became roads "completed in 1921."

The conditions surrounding labor and material supply were vastly improved over previous years. Labor was extensively out of a job, and looking for one. Once on the payroll, labor wanted to keep its job—which made for efficiency. Many contractors stated that the workmen were delivering two to three times the output of previous years, for one-third to one-half less wage. The materials of construction were readily available everywhere.

The railroads were in a position to take all the traffic offered—and more. Construction equipment was in great demand, but the improved conditions permitted the manufacturers to ship their orders with dispatch. Few jobs were delayed pending the arrival of equipment.

Good construction weather, also, prevailed throughout the greater part of the year.

The results of these favorable conditions begin to be apparent as the various state organizations report what they have done during 1921. *Over sixty-two million* square yards of concrete pavement were completed, including street and alley work of this type. About 30,000,000 square yards of this amount were carried over from uncompleted contracts of 1920. On December 1 there were approximately 22,000,000 sq. yds. in contracts uncompleted, and which will have to be carried over to 1922. This unfinished work is smaller in amount than was the case at the close of either of the years 1919 or 1920.

Some of the individual state records are especially creditable. Michigan and Wisconsin each completed the equivalent of about 340 miles of concrete road 18 ft. wide, representing nearly 98% of the program for the year. Iowa practically equaled this record as far as the percentage completed is concerned, but did not have such a large mileage under contract. Iowa did not place a large amount of new concrete road under contract—about 32 miles—but completed more than 160 miles of concrete on the new contracts and those carried over from 1920.

Pennsylvania, as usual, led in mileage actually completed during the year, with approximately 640 miles of concrete 18 ft. wide. New York is second, with 530 miles, and Illinois third, with 450 miles.

Illinois leads all the states in the amount of concrete highway placed under contract during 1921, with a total of about 7,375,000 sq. yds. of pavement, equivalent to 698 miles of 18-ft. slab.

Minnesota awarded nearly 140 miles and completed 100 miles. Approximately 65 miles are under contract now for completion during 1922.

Kansas contracted for about 60 miles of new work during the year; completed roads of concrete total over 83 miles during 1921, and about 47 miles will be carried over the winter. Oklahoma completed about 73 miles on new and old contracts, and there remain about 50 miles to be completed next year on existing contracts. New contracts during 1921 totaled 58 miles.

Maricopa county, Arizona, probably is entitled to distinction as having built more new concrete highways during the year than any other single county in the country—107 miles are reported as having been laid by Twohy Brothers, contractors, under the direction of R. C. Perkins, chief engineer for the County Highway Commission, on the Maricopa County Bond Issue System.

Of the Pacific Coast states, California still occupies the leading position held for several years; 365 miles were placed under contract, and 339 miles of old and new contracts completed. About 140 miles will be carried over to 1922.

Oregon is another state which nearly "cleaned up" its 1921 program. Practically 30 miles of 1920 contracts were uncompleted at the beginning of the year. New contracts for nearly 44 miles were awarded, and of this program some 60 miles were completed and opened to the taxpayers. Less than 14 miles will be carried forward to the 1922 season.

The state of Washington added over 200 miles of concrete to its paved highways during the year. The famous Pacific Highway, in the western portion of the state, is now almost completely paved. This highway serves a section popular among tourists throughout the year.

Altogether, the country has added the equivalent of more than 5,800 miles of concrete paved highway, 18 ft. wide, to its state and county systems during 1921—an achievement of construction engineering which is a credit to the highway builders.

Supplementing the review from the *Concrete Highway Magazine,* a chart (Fig. 1) is here presented showing awards of concrete pavements each month for the last three years. It is noted that there is some tendency toward a larger proportion of awards early in the spring or during November and December. This tendency should be encouraged, as it seems to be in the interest of both the contractors and the job.

The largest volume of awards still continues to come in the months from May to August. While this is to a certain extent unavoidable, it results in many contracts being started during one construction season and carried to the following season in an uncompleted state. Another chart (Fig. 2) is a comparative diagram showing the awards for all types of concrete pavements for several years past.

RESEARCH

Nineteen-twenty-one stressed some important developments in concrete highway research. Work has been going forward at the Arlington Experimental Station near Washington, D. C., operated by the Bureau of Public Roads. A series of machine impact tests on plain concrete slabs 7 ft. square was completed and results tabulated.

After the completion of that series a new set of slabs was made, nearly all of them with various types of reinforcement. The machine impact tests on these reinforced slabs will be started in the early future and carried to completion. In this way it is anticipated that engineers will have available some basic data for the design and use of reinforcement. The Illinois Division of Highways' tests on the Bates road, near Springfield, and the experimental pavement built by the Columbia Steel Co. near Pittsburgh, Cal., involve studies still in progress and promise interesting developments during 1922.

A very important series of traction tests was started at the Massachusetts Institute of Technology under the direction of Major M. A. Ireland, Quartermaster Corps, U. S. Army. A number of industries are co-operating in the support of the research work under Major Ireland's direction. This consists of studies of motor truck operation over various types of pavement, concrete being selected for the first investigation. The studies are on the effect of surface resistance upon gasoline consumption, also the effects of gradients and curvature upon truck operation. This series of tests is one of the most ambitious automotive investigations ever started. Work has been interrupted by winter weather, but will be resumed when conditions permit. Highway officials throughout the country are watching all of these tests with keenest interest.

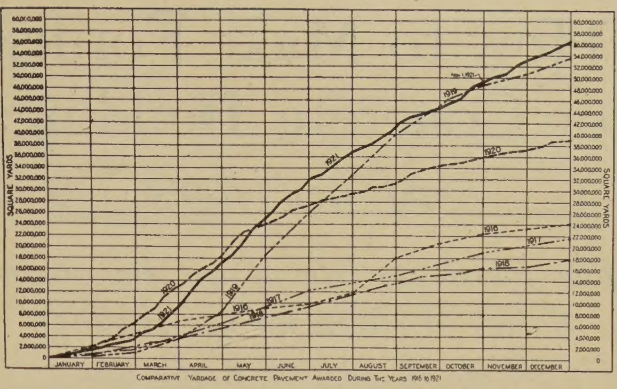


Fig. 2—Comparative Yardage of Concrete Pavement Awards in Years 1916 to 1921

TRAFFIC PROBLEMS

It is very evident that highway officials, in addition to their interest in pavement design and construction details, are taking a greater interest in traffic problems than ever before. This is bound to have an important effect upon future planning, particularly as to location of important highways. Motor vehicle operators show increased appreciation of the rigid non-skid pavement, as is evident by expressions of opinion from owners and operators in all classes of traffic.

REINFORCING

There has been a tendency toward more extensive use of reinforcement in concrete pavements during 1921. Pennsylvania advanced its reinforcement requirements to a specification calling for 56 lbs. of metal per hundred square feet of pavement. In Massachusetts a new pavement design was worked out involving the use of about 10 lbs. of steel bars per square yard of pavement. The pavement slab is also divided longitudinally by a vertical joint, with the idea of controlling longitudinal cracks.

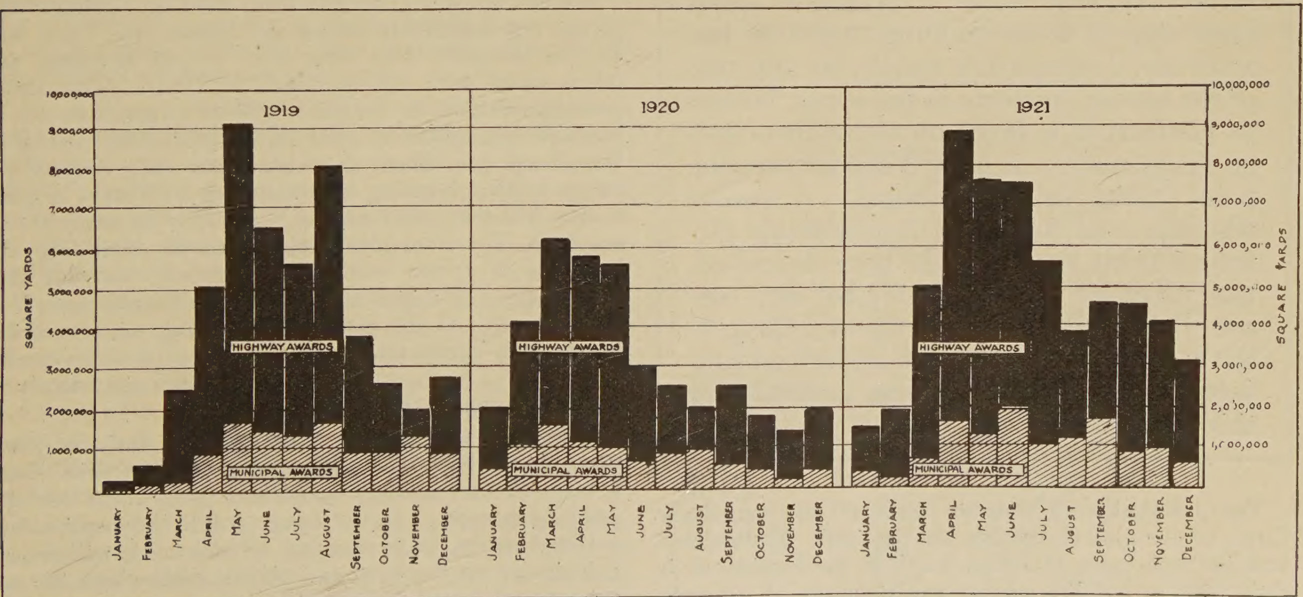


Fig. 1—Yardage of Concrete Pavements Placed Under Contract Each Month for Three Years

Tendency toward early awards, also larger amount or proportion of the year's total awarded during fall and winter months, instead of crowding all awards into May-August period, as in 1919, resulting in larger proportion being actually completed each year.

How to Make Forms for Concrete Buildings —*Footings*

The First Article of an Important Series Written for the Builder Who Wants to Know the Subject From the Beginning

By William F. Lockhardt
Lockhardt-Byrne Co., New York

The literature of form work is scanty. It especially fails to meet the needs of builders who are obliged to begin at the beginning to study the subject. Contractors and superintendents have repeatedly asked Concrete to publish articles whose authors would not take it for granted that their readers already knew most of the subject. The editors cast about for the right man to prepare such articles, and were fortunate in getting the promise of William F. Lockhardt to do the job. The first article of the series, on "Footings," is presented this month; next month, "Walls." Mr. Lockhardt's descriptions of form work are based on the actual practice of some of the most successful concrete building contractors in the United States. Various methods have been tried, and these methods have survived. If any reader is in doubt about some step in form building, when he has read Mr. Lockhardt's article on any one of the special subjects in the series, he will be conferring a favor on the editors and on many readers if he will ask to have the point more fully explained. A reader who has used form building methods different from the methods here described, and which he believes better for any reason whatever, will be adding something to the consideration of a very important subject if he will describe those methods for this magazine.—The Editor.

For practically all concrete work of any magnitude forms of one kind or another are required. Their direct and indirect costs therefore have to be considered in estimating or building almost any structure of concrete. The direct cost is of course obvious. It will include the cost of the lumber and the labor to receive it, as well as the cost of fabricating, together with the additional cost of erecting and stripping.

The indirect cost is not so plain. It will include all sorts of expenses caused by lack of sufficient forms, poor design of forms, faulty handling, etc. There will be time for laborers or cement masons cutting and patching to make good defective surfaces on the finished concrete caused by poor form work; removing the fins left where the concrete ran in between loose fitting boards; straightening up bulged columns and walls and sagged beams. In addition, if the forms are poorly designed, or are heavy and cumbersome to handle, the speed of the entire operation may then be retarded, and to the higher direct cost for labor must be added possible penalties for failure to complete on time, capital tied up, organizations and equipment not available for new work as scheduled, etc.

These are all things that the "big fellows" have found out for themselves and have known for years. You will notice they very seldom make serious mistakes now along these lines. To avoid any possibility of poorly designed forms, and to get the utmost efficiency out of the carpenter gang, some contractors even go so far as to detail in the drafting room their form construction at the same time that the plans for the building are being prepared.

To many contractors and their carpenter foreman, however, concrete construction is only incidental to their regular work. As a result, the contractor who has been doing mill or frame construction, and the foreman who has not spent a lot of time on concrete work, are often in doubt as to just how to tackle to the best advantage the occasional piece of concrete construction that does come along. This is particularly important where the local carpenters have not been "brought up" on concrete form work; in the larger cities it is usually possible to find carpenters who follow concrete construction almost exclusively, and it will often pay to import a pair of them to help get the gang started right. The writer remembers a small concrete furnace room in a war job in the backwoods, where, because the men were totally unable to grasp the idea, the superintendent finally gave up all hope of being able to strip the forms intact, as is ordinarily done, and let the men have their way, for the sake of getting the job poured. The forms were put together like a job of house framing, nailed up solid, and stripped with an axe, piecemeal, in the shape of kindling wood, after the concrete had set.

We can see then, that the form must be (a) light and cheap, but sufficiently strong to insure true lines, and (b) so designed that they can be put together and taken apart with the minimum of labor. This latter presupposes that no one piece will be larger than can be handled economically with the organization available. On a large job, where there is a labor gang devoted entirely to the stripping and handling of forms, a piece that it will take eight men to carry may be entirely economical. On a smaller job, where the stripping and handling of forms would not ordinarily warrant such a large gang, it might be necessary to borrow men from another gang at the expense of holding up concreting, to give the carpenter foreman a panel that he needed in a hurry. Such an arrangement would very likely be highly uneconomical.

Certainly, we all know these things. Only we sometimes think about them afterward instead of first. There is no particular mystery about successful form work and good form costs. If the forms fulfill the requirements outlined above, their economy or lack of it will depend principally on the care and ability with which the carpenter and labor foremen train their men in handling them with the least lost motion. Make every move count!

Much of the material in these articles will be "old stuff" to the fellows who deal with concrete construction all the time. Some of them may have found better ways of doing a particular piece of work, in which case they ought to let the rest of us in on it. The material given, however, is taken from notes made over a period of years on concrete work, and represents generally accepted methods, principally of interest to the man whose work has not made him a specialist on forms, but who wants to know how the "other fellow" does it.

FOOTINGS

Practically every structure requires footings of some kind. nI building construction there are a few kinds and types of footings that are most generally met with, all very simple to build. As footings are very seldom exposed to view after they have been stripped, old lumber, if available, can often be used in making up the forms with economy. In some few cases, though, generally occurring in city construction, part of the footings will appear in the basement or cellar above the floor, in which case it will be better policy to use new material, to avoid the labor required to give the concrete a good surface afterward. Where any one footing is repeated a number of times, it will generally pay to build a good substantial form that will serve for all the footings of that size and type.

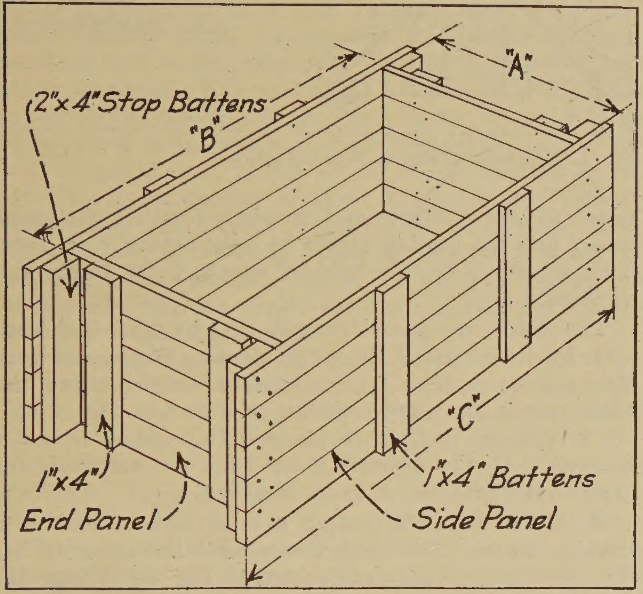


FIG. 1—FORM FOR SQUARE FOOTING

It is these so-called "typical footings" (footings which are most frequently used by engineers and architects) that are given below. Cantilever or "pump-handle" footings and others of unusual design require forms built just the same as any other unusual part of the structure, and each being a problem in itself, no mention is made herein.

Square Box Footing (Fig. 1)—This is probably the most common footing type. For this footing it is frequently only necessary to dig a hole of the right dimensions and depth. It is needless to point out that there is no use of building forms if the excavation is in firm material, that will not collapse readily, or get churned up with the concrete. Occasionally, however, it becomes necessary to build a footing of this kind, so here it is.

In plan the footing may be square or rectangular. The dimension "A" for the end panels is the same as the concrete dimension for that side of the footing. For the "B" length between the stop battens, add to the concrete dimension twice the thickness of the lumber used for the end panels. (That is, if you have made the end panels up out of ⅞-in. lumber, you will add 1¾in.; if you have used 1⅛-in. lumber, you will add 2¼ in.) For the "C" dimension—the over-all length of the long side panels—it is usual to add about 12 in. to the "B" figure. ,This allows for thickness of end panels plus the width of the stop battens, usually 1 by 4 rough lumber.

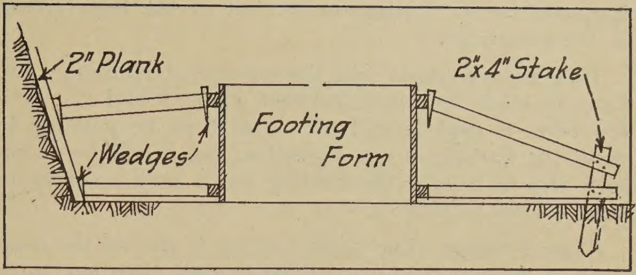


FIG. 2—TWO WAYS OF BRACING A SQUARE BOX FOOTING

If the sides are very long, they should be braced to keep them from bulging. The bulge won't show, but it will take concrete costing so much per yard in place to fill it. The bracing may be done as shown in Fig. 2, which gives two common methods, or by backfilling against the form. The latter is frequently done when it is not intended to use the form again.

Step Footings—The step footing is a common type where the straight box footing would be wasteful of concrete. The steps may be two or three, but are more usually two, as shown in Fig. 3. Both upper and lower forms are made the same as for the box footing shown in Fig. 1. Usually only the form for the first step is set before concreting is started. After the first step has been filled, and while the gang is concreting the next footing, the box for the second step is set in place, and made fast. Filling is resumed after the concrete in the first step has set up enough so that the weight of the concrete in the upper step will not cause it to overflow.

Sometimes top and bottom forms are set at the same time, the form for the upper step being held in place by pieces of 4 by 4 or scantling nailed across the top of the lower box, as shown in the drawing. This form has to be filled in two stages just the same, however, to keep the concrete in the lower step from overflowing, just as when the top box is placed afterward. Before building the form up in this way, it should be ascertained whether it will be possible to place the reinforc-

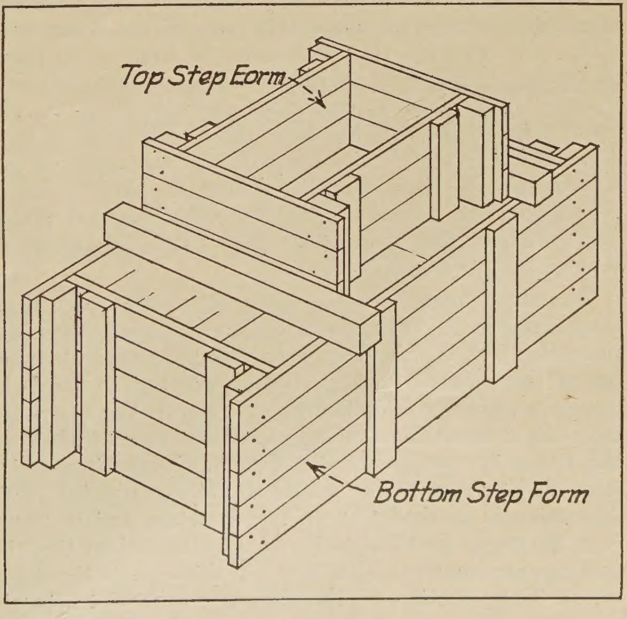


FIG. 3—STEP FOOTING

ing steel in the footing on account of the interference of the scantlings.

Both these methods save the expense of building a top form to close the space between steps 1 and 2. If a top form is used it will of course then be possible to spout the footing in one operation, but it will be necessary also to weight the footing down very securely to keep it from lifting.

Slope Footing—The slope footing is one of the most common designs found in buildings more than one story in height, or where the soil is soft and of low bearing value. As shown in Fig 4 (a) a slope footing may be divided into two parts (both poured monolithic, however), the "ring" or box section at the bottom, which rests on the earth, and the sloped upper section, on the flat top of which the column stands. The method of placing concrete and steel in one of these footings has an important bearing on the way the form is built.

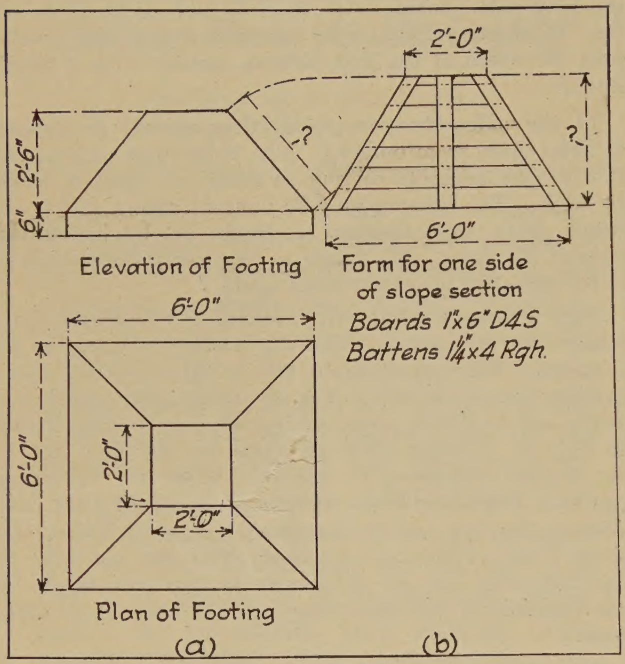


Fig. 4—Slope Footings

Owing to the small size of the opening at the top of the slope section, it is generally impossible to place the long reinforcing bars while this part of the form is in place. As a result, it is customary to first set in place the "ring" and backfill against it to keep it from bulging. Concreting is then started and kept up until all but about 2 in. of the ring has been filled. The steel is then placed, and after all the bars are in, concreting is resumed until the ring is full. While the steel is being placed the four panels for the top section are assembled on the bank and as soon as the ring is full the assembled form is put in place as a unit.

The slope panels for the top section offer very little more trouble in laying out and assembling than the preceding box types. Fig. 4 (a) shows a typical drawing of this kind of footing. When we start to build the panels we usually find that we can get all the necessary dimensions from the footing plan with the exception of the dimension parallel to the slope of the footing, which is needed to give us the width of the form panel. This dimension is marked (?) on the drawing, and is found just the same as the length of a rafter when the rise and run are known. The "rise" in this case is the depth of the slope section of the footing—2 ft. 6 in. in the drawing. The run will be one-half the difference between the top and bottom dimensions for that particular side. For the footing given, by subtracting 2 ft. from 6 ft. we get 4 ft., one-half of which, 2 ft., is the run mentioned above.

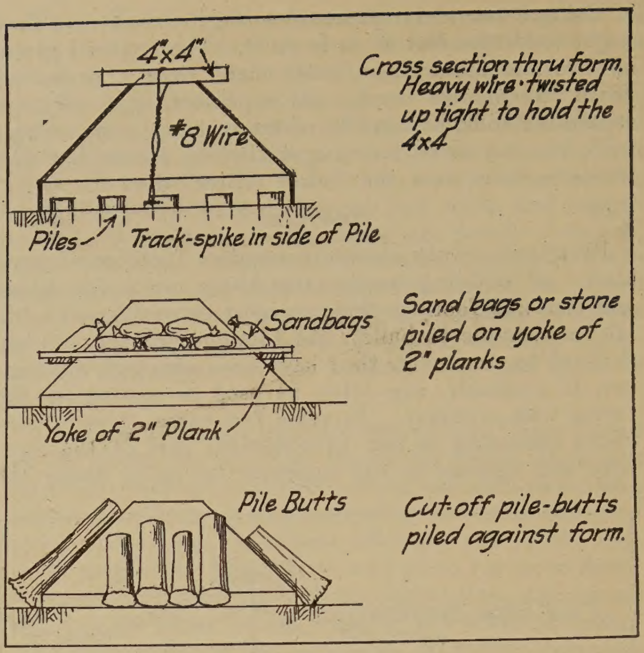

4x4"
#8 Wire
Cross section thru form. Heavy wire twisted up tight to hold the 4x4
Piles
Track-spike in side of Pile
Sandbags
Sand bags or stone piled on yoke of 2" planks
Yoke of 2" Plank
Pile Butts
Cut-off pile-butts piled against form.

Fig. 5—Holding Down a Slope Footing

The panels are generally made of 1 by 6 roofers, with 2 in. by 4 in. battens along the slanting edges, and with intermediate battens 1¼ in. by 4 in. rough lumber, the whole panel being put together as shown in Fig. 4 (b). On very large footings, 5 ft. or 6 ft. wide, it is better to make all the battens 2 in. by 4 in. material, for greater stiffness and ease in handling.

With this type of footing it is always necessary to provide means of holding down until the concrete has set. Several methods are shown in Fig. 5. Where the footing is not on piles, to which it may be wired down, it is necessary to provide sand bags or other suitable material for providing sufficient weight. To carry the sand bags a plank yoke is framed up as shown and put in place about one-third of the way up the slope of the footing, to enable the weight of the bags to be distributed to better advantage. Where the footings are on piles, in addition to wiring the forms down, recourse may be had to the accumulation of pile-butts usually to be found on a piling job. These are heavy, fairly compact, and easily handled, and cost nothing.

A detailed article on the construction of a house with concrete block walls and fire-proof floors in March CONCRETE.

Also the second of Mr. Lockhardt's articles on How to Build Forms.

How Shall We Build Our Concrete House? —The Small Unit

The Second of a Series of Articles on the Use of Block and Tile in House Construction—Block Wall Calculations

By A. J. R. Curtis
Portland Cement Association

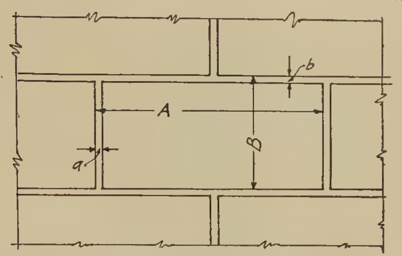


Fig. 19—The Lettered Dimensions Correspond Directly to the Dimensions Given in Table 2.

Table 2—Dimensions of Concrete Block
(See Figure 19)

Block System (Double Rectangular Air Space Type)	A Total Length of Block, including Perpendicular Joint	a Thickness of Perpendicular and Horizontal Joints	B Total Height of Block, including Horizontal Joint	C Block Thickness
Eclipse	16 inches	¼ inch	8 inches	8, 10 & 12 in.
Francis	16 & 24	¼	8	8, 10 & 12
Hayden	16, 20 & 24	¼	8	8, 10 & 12
Ideal	16 & 24	¼	8	8, 10 & 12
Multiplex	20	⅜	6 & 8	8, 10 & 12
Perfect	16	¼	8	8
Pettyjohn	16, 20 & 24	¼	8	8
Republic	16	¼	8	8, 10 & 12
Stewart	16	¼	8	8 & 10
Waterloo-Perfection				
Zagelmeyer	16 & 24	⅝	8	8, 10 & 12
(Single Rectangular Air Spaces)				
Dunn	16	¼	8	8, 10 & 12
Hercules	16, 20 & 24	¼	8	8, 10 & 12
Miles	16	¼	8	8
(Elliptical Air Spaces)				
Besser	16	¼	8	8, 10 & 12
Brandell	16	¼	8	8, 10 & 12
Hobbs	16, 20 & 24	¼	6 to 12	8, 10 & 12
U. S. Standard				
(Double Wall Types)				
Anchor	16	5/16	8	8
Bragstad	24 inches	¼ inch	8 inches	10 inches
Climax				
Flexo				
Helm	24	¾	8	10
Hydraulic Ramming	24	H-¼ V-⅜	9	12
Hydrostone	24	⅜	9 & 12	8, 12 & 16
Viani	30		6 & 8	12
(Building Tile)				
Besser	12	¼	5	8 & 12
Blystone	12	¼	5	8 & 12
Eberling	12	¼	5	8, 12 & 16
Erickson	16	¼	6	8
Hy-Test	8, 10 & 12	¼	5	8
McIntyre	8, 10 & 12	¼	5	8 & 12
Picabbs (Adistile)	20	¼	4, 5 & 6	7 & 10

Fig. 19 presents a diagram (reprinted from January issue) conveniently used with Table 2 (also republished from January issue), to calculate the number of block required and to determine the spacing of window and other openings. The prevailing block lengths are seen to be 16 in., 24 in., 20 in., and 12 in., these lengths being given in the order of their popularity. Then the wall length in feet, multiplied by 12 and divided by 16, gives the gross number of 16-in. block required for one full course. If a block length of 24 in. is to be used, the wall length in feet is simply divided by 2 to get the required gross number of block per course. The length of the wall may be varied easily to correspond exactly with the block length used.

Obviously the width of window and other openings, as well as the horizontal distance between openings, preferably should be equal to an even number of whole or half blocks, but if necessary may be otherwise.

Block heights vary from 6 in. to 9 in., in common practice. Eight inches is the commonest height for 16-in. length, and 9 in. for 24-in. length of block. Story heights in the building should always exactly equal a given number of courses, and it is desirable that the height of all openings exactly equal a given number of courses. The block can be cut where necessary for fractional heights, but at considerable expense, usually unjustified.

In general, the designer should make the dimensions of the structure conform to the sizes of units available, making all dimensions such that whole and half block will suffice throughout the work. Occasionally the use of quarter block may be justified, and where absolutely necessary to the faithful reproduction of the architect's conception, it is quite as possible to meet any dimension requirements by cutting block as would be the case in the use of brick.

Construction Methods—Foundation Walls

In many localities where a dependable supply of concrete block is available, it may be said modestly that block has become the standard foundation wall material for dwellings, garages and other buildings of moderate height. In Bay City, Mich., for example, it is said that 95% of the residence foundations put in during the last few years are of block. An increasing number of real estate development concerns are using block for the foundations of their houses. We do not know of any who have ever abandoned the block method after once becoming familiar with good block practice and the advantages of the type.

What are these advantages? Here are some of the more important ones: (1) Quick and easy to lay up made-in-advance stockable concrete, almost regardless of season or weather; (2) standard concrete block have a known guaranteed strength, uniform throughout the job, only the services of regular masons, without special concrete training, being necessary to lay up the walls, and (3) concrete block are simpler to lay than field or quarried stone or brick, being uniform in size and true in shape, which means that a mortar joint of uniform thickness is all that is required to bed the block perfectly.

Recommended Practice for the Foundation

In Chicago and in a few other large cities, building regulations require that concrete block used in the walls below grade be filled with "slush" concrete in such a manner as to make such walls practically monolithic. This practice not only gains nothing where the block and workmanship are of reasonable quality, but the filling of the air spaces is a needless expense of materials and labor, and defeats the obvious function of the air space—to prevent the basement walls from sweating.

If the object of filling the block is to get more bearing area, it would be wiser to use a wider block of same design, having heavier walls; if it is to provide more stability against the pressure of earth fills, use wider block, if necessary, or lay up the block in such manner as will produce pilasters as frequently as required. However, for ordinary residence construction and for moderate sized buildings of all kinds, both the hollow and the two-piece block construction will be found satisfactory, if due regard is paid to a few essentials.

Having in mind that the functions of the foundation

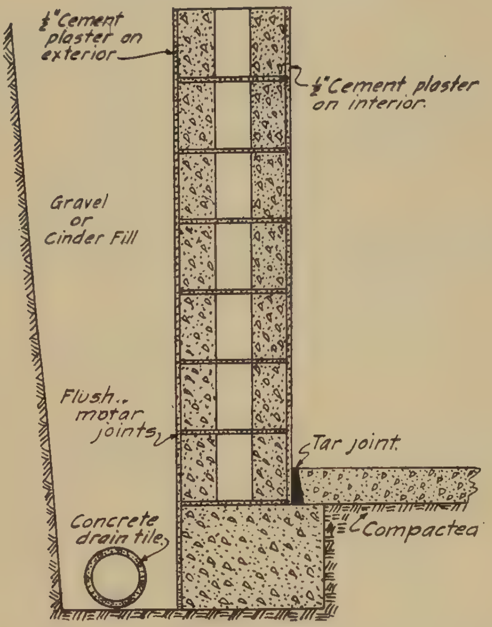


Fig. 22—Standard Method of Building Concrete Block Basement Wall—Walls So Constructed with Average Workmanship Will Be Water-Tight, Well Insulated, and Free from Condensation on the Inside

require it to be of sufficient strength to support the imposed load and resist side thrusts and also to be absolutely watertight, the following considerations include the most important elements of good practice. (See Fig. 22).

1. The block must be strong and watertight complying with standard specifications of the American Concrete Institute, which require at 30 days a compressive strength of 1,000 lbs. on the gross area, and an absorption of not over 10% in 48 hours.
2. Portland cement mortar (1:2 mixture of portland cement and suitable sand, with small amount of lime added) should be used exclusively and the block previously moistened, then carefully laid, buttering both ends.
3. Block foundations should always rest on a monolithic footing carefully leveled, but left rough on top. The upper surface of the footing should be clean and painted with a cement and water wash and the mortar for bedding the first course of block spread immediately.
4. A line of drain tile should be run around the outside of the wall at approximately the same level as the footing and carried to an outlet.
5. The wall should be coated on the outside on the same manner as is customary for other masonry—using rich cement mortar or an approved asphaltic compound. (See page 23.)
6. Backfilling must be carefully placed and thoroughly compacted next to the wall, and the surface given a gentle slope away from the building.

Experience has shown in hundreds of cases that the block showing an absorption of 10%, as required by the American Concrete Institute, will make absolutely watertight walls. Such block are generally found in our larger cities and in hundreds of the more progressive towns. Recommendation No. 4 contains a suggestion which is indispensable for any kind of building in low places, particularly in heavy clay soil. If the contemplated construction is in a location obviously free from possibility of ground water pressure, this precaution, as well as those contained in recommendations 5 and 6, may be unnecessary, granting that the first three recommendations have been carefully complied with.

Walls Above Grade

The mason experienced in laying up brick or stone work finds very little out of the ordinary practice in the laying of concrete block. Block is somewhat different in that it requires the slower handling of larger units. The greater weight of the block makes it necessary to use a somewhat stiffer mortar, and there is a greater uniformity of size and regularity of shape than is found in other masonry materials.

Fig. 23—Recommended Method of Finishing Concrete Block Foundations, Using a Half-Inch Coat of 1:2 Cement and Sand Mortar

[Editorial Note.—Light weight concrete building tile, in smaller units than block and with thinner webs, are coming into increasing popularity. For back-up units, as a base for stucco, for partitions and curtain walls, and for bearing walls in light residence construction, or in heavier work if the tile are of high strength, these newer units promise to displace the heavy units where the latter are obviously unnecessary, and to meet more satisfactorily, because of true shape, the burned clay tile which have become so popular for light walls.

An important point in favor of the light units is that most of them can be picked up by the mason and laid in the wall with one hand. A little experience has made it possible for masons to lay almost as many tile in a day as common brick, and every tile displaces several brick. Such units save a large amount of mortar as compared with brick.

In this connection attention is called to an omission from Mr. Curtis' first article of mention of Dunn tile and Eberling tile, both of which have been on the market for some time and had very extensive use. Eberling tile made a remarkable success in Detroit, for both curtain and bearing walls of residences, factories, garages, theatres and other structures, and many hundreds of thousands of them are in satisfactory use.]

As they come from the mold, concrete block do not usually run as true as specially tooled dimension stone, but if block of extremely accurate dimensions are required they can be produced by an additional expense, much less than the cost of truing up natural stone. It is practical to lay up block 16 in. long in horizontal joints ¼ in. deep and 24-in. block in joints ⅜ in. deep. Special pieces of unusual length, such as sills and linels, are made more accurately than ordinary wall block, and lay up nicely in ¼-in. or ⅜-in. mortar bed. Flush joints are recommended for surfaces to be covered with plaster or stucco and a moderately concave or "struck joint" for block surfaces which are to remain exposed.

The procedure in laying up the walls varies only slightly as between those to receive stucco and those to remain exposed. Obviously, block to be covered are laid up more quickly, not requiring careful finish of the joints. Injured block which remain structurally sound can be laid, entirely eliminating culls.

Where the water table course is to be covered with stucco, it is usually laid as shown in Fig. 24. In the walls of exposed surface block, the sills, lintels, caps and other special pieces may or may not be made to protrude, according to the requirements of the design. In stucco covered block walls these specials are commonly (although not necessarily) brought out to extend half an inch beyond the finished stucco.

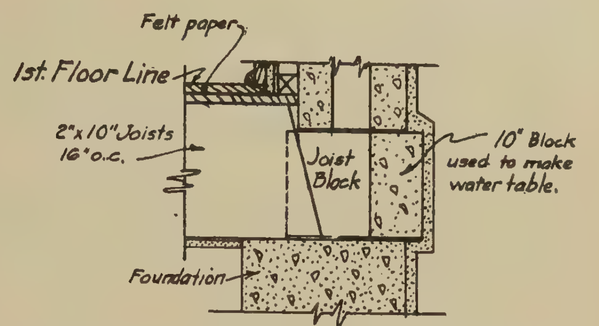


FIG. 24—SUPPORT FOR ORDINARY WOODEN FLOOR CONSTRUCTION, SHOWING THE USE OF A 10-INCH JOIST BLOCK COURSE (ON 12-INCH MONOLITHIC OR BLOCK FOUNDATION), USED TO PRODUCE WATER TABLE

Idealism in Construction

Even a work-a-day magazine like this one must sometimes pause with its shovel or its trowel in hand to note a particularly fine expression of the higher purposes by which its industry is moved. The following is from the brief address of Arthur Bent, Los Angeles, Cal., newly elected president of the Associated General Contractors of America, at the third annual convention in Cleveland, January 20.

"The reason the A. G. C. is such a lusty young giant tonight is because it is inspired with a spirit of unselfish co-operation among ourselves, a desire to serve our public more worthily and a purpose to lift our craft to higher levels of integrity and honor.

"There is a very beautiful legend, an impressive one, I think, so old that its origin is lost—I have never been able to discover it. It goes like this: Four men stood up with God when He made the world, and watched with wonder as the shimmering sphere flung from the fingers of Omnipotence, found the place in the shining galaxy of stars, and one of the men said, 'How was it done?' And God said to him, 'Go, find out for yourself.' And that man went and became a scientist.

"And the second man said, 'What is it for?' And to him God said, 'Go, find out for yourself.' And he went and became a philosopher.

"'Give it to me,' the third begged. And to him God said: 'Go, possess it for yourself.' And he went out and became the business man.

"The fourth said nothing but fell down and worshipped, and God said to him: 'You, too, shall go, and because your soul burns within you, you shall create beauty,' and that man went and became the artist.

"Now, may we not, reverently and not unfittingly, add to this noble group of God's journeymen the constructor? We who forerun all the others? We who have straightened the path for their feet? We, without whom their high destinies could not be wrought out and by whom all their visions are crystallized? We work and delve for science in its onward march, and harness its magic to ways of usefulness. The bewildering and marvelous structure through which business functions is the work of our hands. Philosophy leans upon us heavily to demonstrate its theories of life, and even to art we give its tools and make its dreams of beauty imperishable.

"We are the hands through which nearly all of human thought and all of material progress are expressed. Through our highways and railways and lighting and heating and temples and schools and homes we touch all life intimately, and come very close indeed to the heart of humanity, and with that vital and varied contact comes to us an impressive but inspiring responsibility. It is given to us, if we see it rightly, to raise the standard of every man's service by the fidelity of our own.

"I make no apology for such idealism in an organization like this, because whatever our industry is today is the sum total of the thoughts that all the contractors in the world have about it, and it never will rise above that level. And as that level advances to higher planes of integrity and service, we shall travel further and further away from that stigma of sordidness which has clouded our history in the past, and it is given to the A. G. C. to carry that bright banner in the very vanguard.

"Of course, ethical achievement is not statistical. We can't measure our progress along those lines. Nevertheless, I firmly believe, and you do, too, that it will be our real, our most profitable progress, and the span of our activities is not limited to our own present interests.

"We are trying to make contracting a finer thing for those who will come after us. We are consciously sowing seeds which will be harvested by those whom we can never know. Is there any finer thing in life than that?

"I will just leave with you that thought, expressed again in a homely little poem called—

THE BRIDGE BUILDER

An old man, traveling a lone highway,
Came at the evening cold and gray
  To a chasm deep and wide.
The old man crossed in the twilight dim,
For the sullen stream held no fears for him.
  But he turned when he reached the other side,
  And builded a bridge to span the tide.
"Old man," cried a fellow-pilgrim near,
"You are wasting your strength with building here;
Your journey will end with the ending day,
And you never again will pass this way.
You have crossed the chasm deep and wide,
Why build you a bridge at eventide?"
And the builder raised his old gray head:
"Good friend, on the path I have come," he said,
"There followeth after me today
A youth whose feet will pass this way;
This stream, which has been as naught to me,
To that fair-haired boy may a pitfall be;
He, too, must cross in the twilight dim.
Good friend, I am building this bridge for him."

Pipe Men in Convention

Association Efforts Are for Standard High Quality

The big thing about the American Concrete Pipe Association, which had an unusually well attended convention in Chicago January 19, 20, and 21, is its well sustained policy of hewing continually to the line of quality first. Instead of wasting energy in offensive and destructive propaganda, it is busying itself about the quality of its own goods. Much of what the concrete pipe makers have to combat is based on three types of misleading propaganda, (1) Statements based on developments and opinions recorded a generation or more ago when concrete pipe was in its infancy, and the factors of quality imperfectly understood; (2) Exaggerations of isolated conditions as to distinctive influences, such, for instance, as unusual sewer gases and concentrations and rare instances of alkali attack—when as a matter of fact both these agencies, under certain extremes, are destructive not alone to concrete of less than the best quality, but also to all the materials which engineers might utilize; (3) Rank falsehoods and misrepresentation—as, for instance, the report of sewer failures where no sewers were ever built.

Aside from necessary defense under these fruitless attacks, the concrete pipe people are for the most part tending to their knitting, frankly recognizing their own problems and rapidly solving them or going about such studies as are necessary to solve them.

This frankness, this promptness in setting their own house in order, is the foundation rock of real engineering progress, and it is upon such progress that concrete pipe for all purposes is being adopted so rapidly.

The high lights in the convention were in the reports of progress being made on alkali investigations, of the standards being developed for culvert pipe, and sewer pipe, and in discussions of manufacturing practice.

George H. Bullen, president of the Concrete Pipe Co., Portland, Ore., which operates 14 plants in Oregon, Washington, Idaho, and Montana, attended the American Concrete Pipe Convention for the first time and addressed it on some of his experiences in the development of concrete pipe to the point of its general acceptance for sewer work, since the company began operations several years ago. Most of the work in that territory is now going to concrete, but it has not been without a struggle. One interesting note in his remarks was in connection with the attitude of the average concrete products manufacturer, especially, perhaps, in the manufcature of concrete pipe towards the engineer who must be counted upon to specify the kind of material that is to be used. He recalled that in the early stages of the development of concrete pipe on the Pacific Coast, his company regarded the engineer with suspicion and believed that all engineers in a position to specify the kind of pipe to go in a sewer were dead against concrete. He found as he got acquainted with engineers that most of them were not thoroughly committed to other materials nor dead set in their ways, but were perfectly willing to be convinced of the superior quality of another material. They had, however, to be convinced upon an engineering basis, and he wonders how his company succeeded at all when he looks back upon the sales methods that were originally employed. He urged concrete pipe manufacturers to be very careful of their attitude toward the engineers. He explained that in his own business the Concrete Pipe Co. have come to recognize the importance of the engineer in the development of a satis factory pipe for sewer and other purposes, and that an engineer is in charge of each of the company's fourteen plants. In this way the company is able to meet the specifying engineer on an equal footing with a thorough understanding of his requirements.

The thought of the organization was sketched in the report made by George E. Warren, who resigned as secretary of the Pipe Association in November, to become assistant general manager of the Portland Cement Association, and extracts from his report are as follows:

> The association has been embarrassed many times by the lack of standard specifications, but more particularly by the lack of standard quality of the products we represent. There has been some confusion in the minds of our member companies as to just how the interests of the reinforced pipe manufacturers are related to those of unreinforced or machine-made products. The last year has shown quite clearly the intimate relation existing between them. Unsatisfactory experience with one class or the other of pipe has been reflected in loss of sales for all kinds of concrete pipe. Difficulties arising from poor products in one state are widely interpreted the country over as applying to concrete pipe, without regard to how or for what specific use. Standardization of quality is of primary importance to every manufacturer, wherever located, and whatever products he sells.
>
> When substantially our entire industry is producing material which will conform to the accepted standard requirements, then the prejudices will rapidly melt away.
>
> To obtain the proper recognition in the engineering field, we have selected as the proper medium of contact the engineering societies, consisting primarily of the American Society for Testing Materials, the American Concrete Institute, and the various state drainage and engineering societies wherever they exist. Engineering practice is tending toward the adoption of nation-wide specifications.
>
> Work in two committees, one on sewer pipe and one on drain tile, has been very active during the last year. Changes in the specifications radically affecting our interests have been proposed in both committees, having to do principally with technical requirements for products against alkalies and acids. Our Secretary, Mr. Loving, has been made secretary of the reorganized pipe committee of the American Concrete Institute and is carrying on perhaps the most important investigation of concrete sewer pipe that has yet been made.
>
> The problems still before all of these committees include the age-old questions of the effect of sewage on concrete sewer pip, the effect of peat and alkali soils on culvert pipe and drain tile.
>
> The most interesting phase of the culvert pipe situation has been the activity of the Joint Committee on specifications. It consists of two representatives each of the American Society for Testing Materials, American Society of Civil Engineers, the American Railway Engineering Society, American Association of State Highway Officials, American Concrete Institute, Bureau of Public Roads (U. S. Department of Agriculture), and the American Concrete Pipe Association. Here we have combined the producing, the consuming, and the neutral or engineering interests into one body for working out specifications. This will eliminate, if successfully adopted, the particular annoyances which now arise from the small differences in dimensions, for example, which exist between state specifications. One of our members located close to four different states has to contend with four state specifications requirements, differences being minor but nonetheless expensive with which to contend.
>
> Dean Anson Marston, of Iowa State College, Ames, is chairman of the committee, and, quite fortunately, he has under way an experiment to determine the loads on culvert pipe, on which already nearly $20,000 has been spent. We are having the full benefit of this experimental work. The committee met in November, and will meet again in February. The representatives from this association are Paul Kircher, Massey Concrete Products Corp., Chicago, and C. F. Buente, Concrete Products Co., of America, Pittsburgh, both of whom are members of our own culvert pipe committee. An indication of how these specifications are to be received is had in the requests for copies of the progress report by nearly 150 state highway officials who heard Dean Marston's presentation of the subject at the recent convention of highway officials at Omaha, Neb.

A. N. Shearman, Knoxville, Tenn., was re-elected president; vice-presidents re-elected are Harry Cain, Mankato, Minn.; E. F. Bent, Los Angeles, and A. M. Hirsh, Ampere, N. J. M. W. Loving is secretary.

Barriball Plants in Cleveland

Concrete products manufacturers visiting Cleveland to attend the convention of the American Concrete Institute, February 13 to 16, will probably find time to visit some of the factories there, which are interesting in the products field.

The work of George Rackle & Sons Co. has been mentioned many times in this magazine. The plant of "the Rackle boys" has in its time been a sort of training school in the products field. More products manufacturers throughout the country probably got their first ideas of the business—especially in trim stone—at the Rackle plant that at any two other plants in the country.

Two new ones are the Barriball plants. One is the plant of George D. Barriball, making Federal High-Test tile,[1] face brick, floor tile and Hobbs and Hayden stripper block, and the other the plant of Barriball Brothers, making High-Test tile, face brick (Peerless machine), Hobbs and Hayden stripper block, under Anchor automatic tampers, and a line of specialties and ornamental work, chief of which is a new type of precast steps of reinforced granite concrete.

The plant of George D. Barriball is famed far and wide for being "clean as a bakery." Mr. Barriball has refused to succumb to the dust and muss which is generally regarded as a necessary evil of the products business. The neatness shows up in the yard (Fig. 1), and in every inch of space inside. Mr. Barriball has developed brick facings which are painted or stippled on

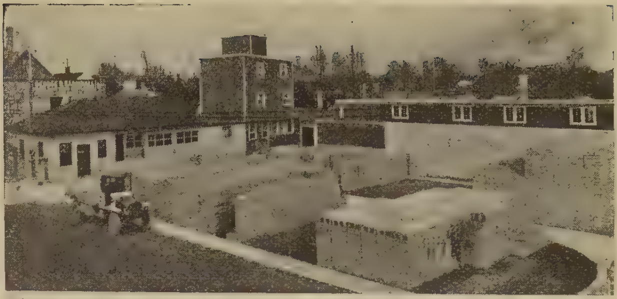


FIG. 1—PLANT OF GEORGE D. BARRIBALL, CLEVELAND, MAKING HIGH-TEST TILE

FIG. 2—THE TILE MACHINE

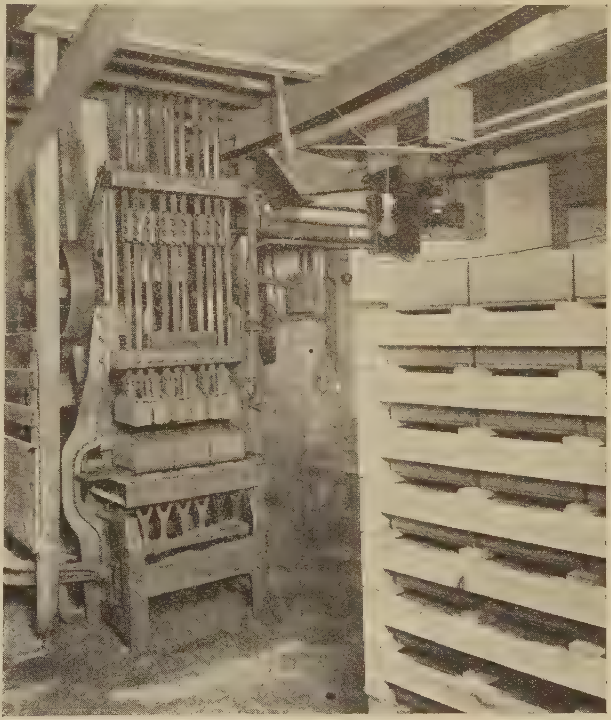


FIG. 3—YARD OF BARRIBALL BROS. PLANT

TEST DATA

The following information was furnished by the Federal Machine Products Co.:

The samples .... are today (Sept. 23, 1920) just fourteen days old, and were taken from the regular production of Barriball Bros., of this city. Made of a 1 to 4 mixture, run of bank sand, which contains a small proportion of loam. Four hours in steam curing rooms.

The blocks had triangular shaped vertical openings as they are laid in the wall. The exterior walls and cross webs were slightly tapered from a thickness of about 1 in. at the bottom to within about ¾ in. of the top; at this point there was a shoulder, giving the walls a thickness of about 1⅝ in.

Three blocks were tested in compression and three for absorption, at the age of 28 days.

The compression tests were made in a 200,000-lb. Olsen universal testing machine. The bearing surfaces of the specimens were capped with a mixture of gypsum and neat cement to insure an even distribution of load. The load was applied through a spherical bearing block.

The blocks for the absorption test were dried to constant weights and immersed in water at room temperature for 48 hours. The absorption is the gain in weight expressed as a percentage of the dry weight.

Block No.	Dimension of Blocks in Loaded Surface inches	Height, inches	Gross Area, sq. in.	Minimum Net Area sq. in.	Compressive Strength Total Load lbs.	Compressive Strength Lbs. per Sq. In. Over Gross Area	Compressive Strength Lbs. per Sq. In. Over Minimum Area	Absorption After 48 hrs. Per ct. by weight
1	11.87 by 7.75	4.75	92	48.6	105,680	1150	2170	...
2	11.87 by 7.75	4.75	92	48.6	104,170	1130	2140	...
3	11.87 by 7.75	4.75	92	48.6	112,130	1220	2300	...
4	11.87 by 7.75	4.75	92	48.6	....	....	....	6.6
5	11.87 by 7.75	4.75	92	48.6	....	....	....	6.3
6	11.87 by 7.75	4.75	92	48.6	....	....	....	6.2
					Av. 107,330	1170	2200	6.4

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[1] The business of the Federal Machine Products Co. has recently been taken over by the Anchor Concrete Machinery Co.

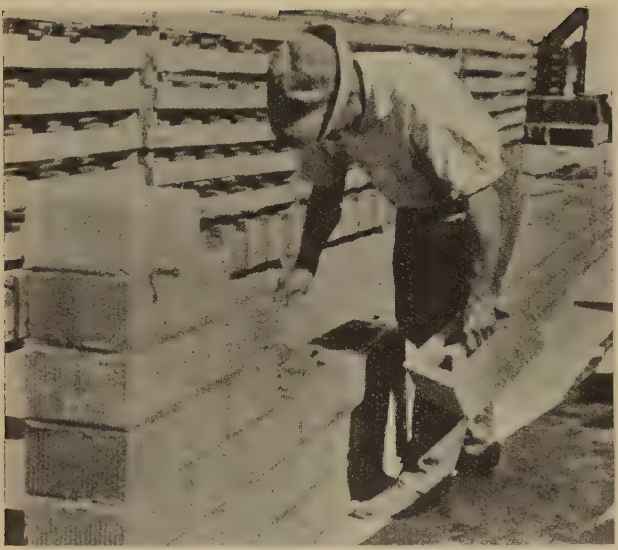


Fig. 4—Laying Up High-Test Tile

the brick after manufacture, and has achieved rich color and decorative effects. He has also spent a good deal of time in developing floor and decorative tile of concrete. The results with both brick and tile are entirely a matter of the taste and technique of the man doing the work. Mr. Barriball thoroughly appreciates the advantage in neat and orderly storage of these decorative units. They are carefully sorted and piled in a room kept free of dust and dirt. Cowan lift trucks and racks are used in handling products.

Barriball Bros. have a neat and orderly plant, but it is a little nearer normal than the plant of their brother. They depend more upon quantity production of standard units, and the production of such specialties as step units. The steps are a patented design of their own development, consisting of riser and tread of light section in one unit, and in such lengths as the work requires. They have a good smooth granite finish, are strongly reinforced, and can bet set in place on a rough masonry base to compete with just an ordinary job of monolithic step building, and with less muss and time spent on the job.

Barriball Bros. have plans ready for considerable plant remodeling to get increased curing room space and additional room for trim and specialties. This will be done by keeping the curing tunnels low and having a large room over them. They operate three Kent continuous mixers.

The light weight tile are finding a ready market in Cleveland and suburbs from Barriball plants. It is used as a foundation unit, as a back-up in some large construction work, and as a face unit in garage construction. It provides an excellent base for stucco in houses. The High-Test tile is 5 x 8 x 12, is readily picked up and placed in the wall with one hand, and is already preferred to burned tile, even at a slightly higher price, because of true lines. The tile are made on the High-Test machine three at a time, under multiple head tampers, which give good consolidation and are stripped out of the mold (Fig. 3). Barriball Bros. report that they ordinarily employ three men on a machine—one operator and two off-bearers (using racks on cars and tracks to curing rooms), and get a production of about 3,000 in ten hours. They found recently that two men—the operator assisting in off-bearing, since most of the operations are automatic, can turn out 2,300 in ten hours, which, though not getting so much out of the machine, gives a higher man-hour production. A report of a test of the tile by the Structural Materials Research Laboratory, Chicago, is as shown on the previous page.

A Man Who Believes in His Work

In Huntington, W. Va., is a stucco contractor who guarantees his work. He is A. Holt, and his shop at 1435 Eighth avenue is an example of his work. He uses the first floor as a work shop and storeroom, and the second floor for living quarters. Mr. Holt is very proud of this portland cement stucco, which he states is as solid as a brick wall.

Early each spring Mr. Holt runs advertisements in which he guarantees all his stucco work and offers to make good any defects in his stucco work in Huntington. That guarantee carries considerable weight, because he established himself there ten years ago. He served his apprenticeship in Scotland more than twenty years ago. Besides doing stucco work, he manufactures concrete flower vases and garden furniture, which he exhibits in his show room.

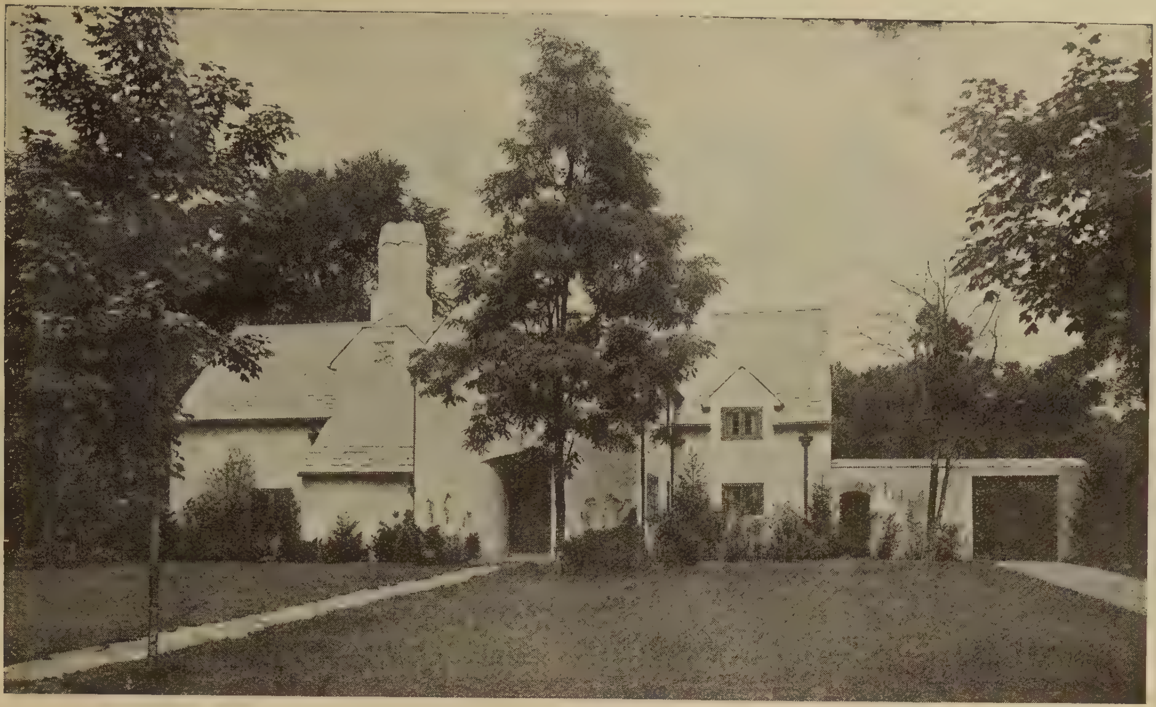
Mr. Holt's Shop, Showroom and Residence

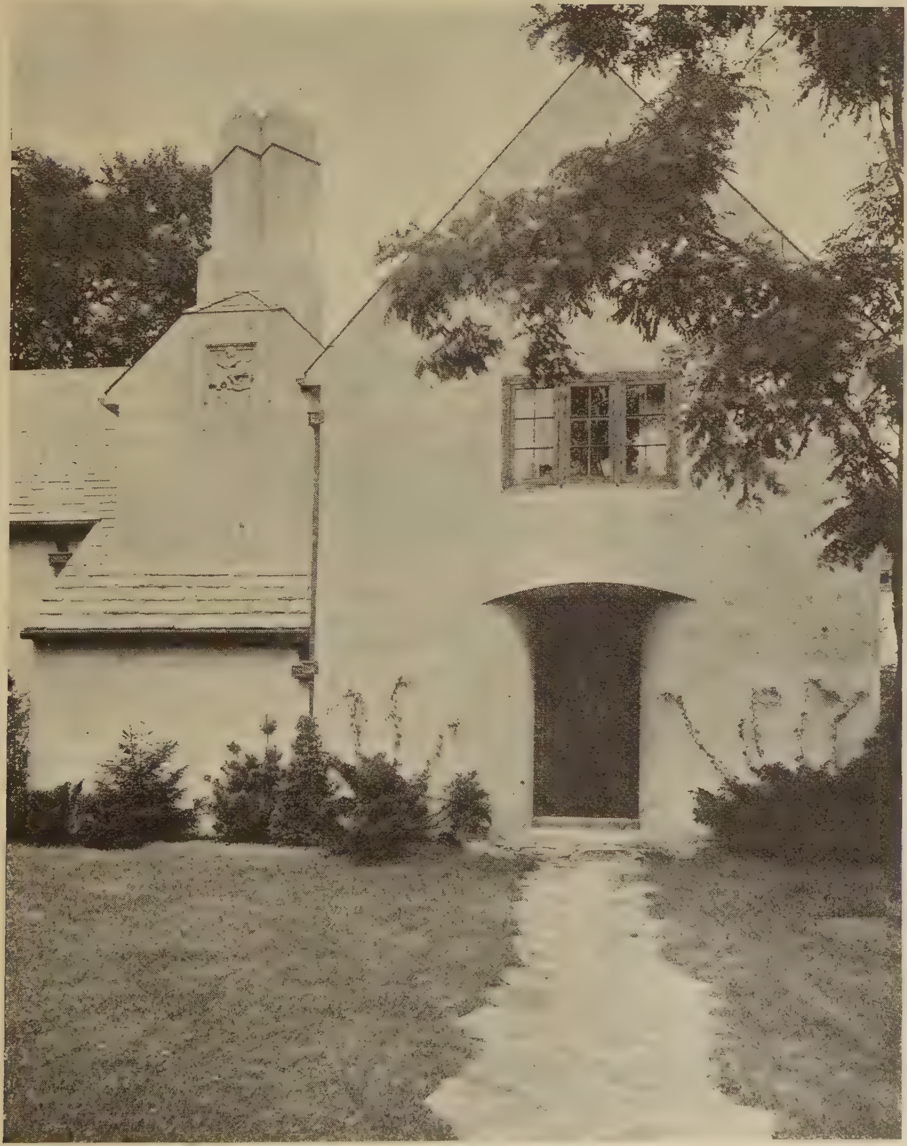
Mr. Holt is evidently one of the kind of stucco contractors the American Concrete Institute committee had in mind in its report on "Recommended Practice for Portland Cement Stucco," in saying:

> Intelligent and high class workmanship is so essential to good stucco that only those contractors who have had sufficient experience to establish their own confidence in the product, and who are willing to guarantee their work, should be employed for its (stucco) application.

Mention was made in the November, 1921, issue of Concrete of the advertising project recently started by the American Vault Co., Brooklyn, N. Y., among concrete burial vault manufacturers to familiarize their customers, undertakers and others, with their product and its particular advantages. Since then it is learned that this movement is urgently in need of support from concerns manufacturing concrete burial vaults who are urged to write the Amerian Vault Co. and find out particulars of the movement.

It is the intention, if sufficient co-operation can be secured from member companies to form an Association of Vault Manufacturers to handle the publicity as it is believed that the sale of concrete vaults can be greatly increased in every locality if sufficient attention is given to educational work with the undertaker.





Stucco Lends Itself to a Great Variety of Surface Effects

A. J. THOMAS, ARCHITECT, 137 EAST 45TH ST., NEW YORK CITY, DESIGNED HIS OWN HOUSE AT SCARSDALE, N. Y.—THE STUCCO WAS PLACED ROUGHLY AND WHEN IT HAD PARTIALLY HARDENED WAS GONE OVER WITH A PIECE OF BURLAP

Courtesy Atlas Portland Cement Co.

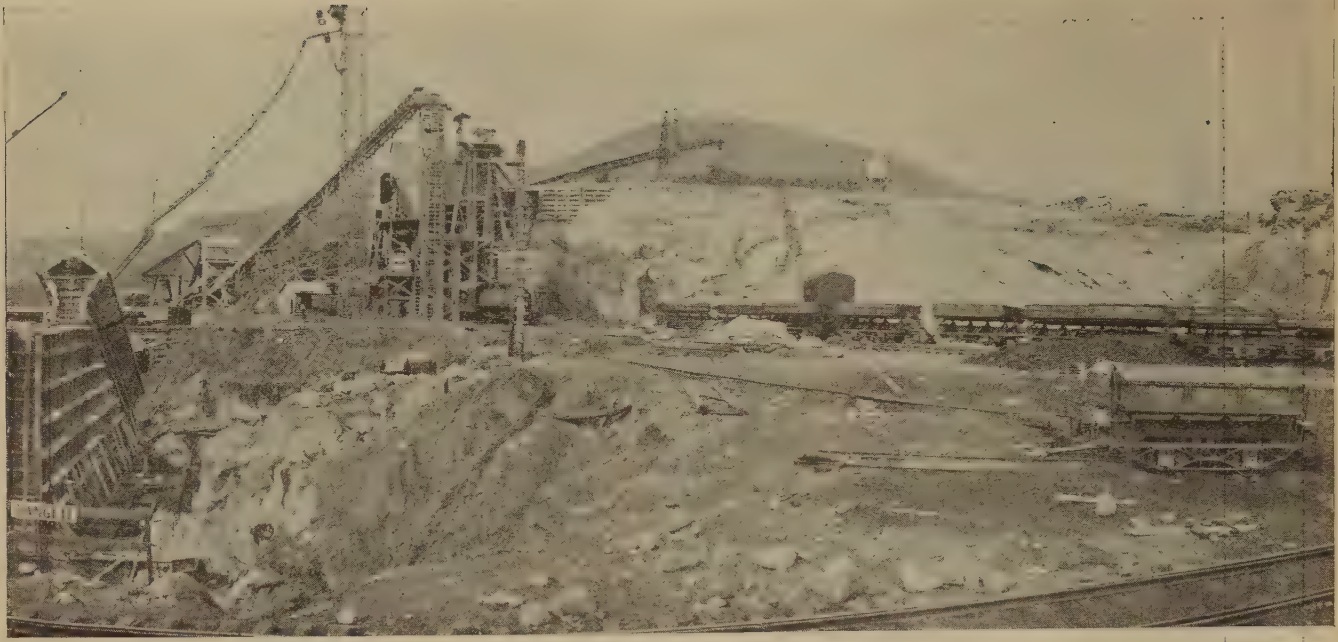


FIG. 1—PANORAMIC VIEW, SHOWING RELATIVE POSITION OF DAM UNDER CONSTRUCTION, WITH THE MIXING PLANT ON THE RIGHT

One-Man Mixers and Bulk Cement on 105,000 Yard Job

Carefully Designed Plant on International Paper Co. Job Near Glens Falls, N. Y.

By H. L. MUCHEMORE
DESIGNING FIELD ENGINEER
ON SHERMAN ISLAND DEVELOPMENT

The Sherman Island Development, under construction by the Parklap Construction Corporation for the International Paper Co., consists of a dam 64 ft. high across the Hudson River at a point about five miles west of Glens Falls, N. Y.; a headrace canal about 3,600 ft. long, and a power house placed at the foot of the rapids below the dam, thus gaining about 18 ft. additional head. The development will contain 105,000 cu. yds. of concrete, for the placing of which a carefully designed plant, using bulk cement and one-man mixers, has been installed.

Stone for the concrete is quarried on the south bank of the river, where a waste-way channel required the excavation of 150,000 cu. yds. of material, all but 30,000 cu. yds. being a very hard granite rock. The faces in the quarry vary from nothing to 43 ft. Cyclone drills[1] were used for all holes over 20 ft. deep, and one-man drills for shallower holes. Loading is by derrick and skip to 6-yd. cars, which are hauled across the cofferdam bridge to the crushing plant, situated about 300 ft. upstream from the mixer plant, or by a Marion model No. 36 steam shovel, mounted on caterpillar traction, to trains of 6-yd. cars, which are hauled to the waste dump. A small amount of stone was taken to the crusher from an excavation for the head works of the headrace canal.

The crushing plant consists of a 36 in. x 42 in. Kennedy jaw crusher, delivering to a No. 8 bucket elevator 66 ft. on centers. A screen, 16 ft. x 60 in., is used with 2⅛ in. perforations, the tailings being returned to a No. 6 Kennedy gearless gyratory crusher,[2] which delivers to the same elevator. Stone passing through the screen is passed by a deflector gate to a 24 in. x 237 ft. conveyor belt, delivering to either stone bin over the mixers, or to a 24 in. x 320 ft. center conveyor belt, which carries the stone up the hill into a storage pile. This storage conveyor ends on a jib projecting 45 ft. beyond the last trestle tower, and has its head pulley and motor 75 ft. above the ground, giving a storage of 25,000 cu. yds., over an area of which a crane can command 90% without any obstruction.

Pit-run sand is obtained directly from the canal excavation, trains running out over the top of the mixer bins. The sand bin is common to both mixers, and is covered with a grizzly screening out all gravel above 1¾ in. About 3,000 yds. of sand for emergency storage is placed by a crane near the stone storage.

Cement is purchased in bulk from the Glens Falls Portland Cement Co., eight miles from the site of the works, and is hauled in 100,000 lb. bottom-dump coal cars. Four cars of the Delaware & Hudson Co.'s 44,000 type have been placed in this service and fitted with wooden roofs, each car roof having four scuttles for loading. The roofs are double, with roofing paper between the plies. The bottom doors are caulked with strands of rope and braced before loading. An average carload of 300 bbls. is hauled. The cars when received are pushed out over a trestle into a cement house, whose center line is parallel to, but 2 ft. 6 in. in front of, the face of sand and stone bins. Eight bins with very steep sides, lined with galvanized iron, are built between the bents of the trestle. Each bin will hold 225 bbls. and terminates in a hopper gate at the bottom, through which the cement can be drawn on to a 14 in. Robins conveyor belt[3] for delivery to the smaller bins, one over each mixer. The

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[1] Cyclone Drill Co., Orrville, O.

[2] Kennedy-Van Saun Mfg. and Engineering Co., New York City.

[3] Robins Conveying Belt Co., New York City.

AND COFFERDAM BRIDGE IN THE FOREGROUND

cement flows quite evenly through the gates, owing to the steepness of the bin sides. Two men dump and clean a car in two and one-half hours. One man is required as belt tender at the bottom of the bins, and another man at the head end of the belt controls the motor and operates the deflector gate, distributing the cement into either mixer bin as needed.

The mixer plant is built around two Lakewood proportioner[4] panels and consists of two stone bins, a common sand bin, two small cement hoppers, properly elevated, and the mixer platforms, and contains in its framing the bents supporting a standard gauge track directly over the bins. The sand and stone bins have walls of open crib or log-house type, built of 2 in. x 8 in. plank laid on the flat. The cement bins are hung on the front of the sand and stone bins, and a tower to carry the head pulley and motor for the conveyor from the crusher surmounts the whole structure. Two 1-yd. Koehring mixers[5] are set up on separate supports in front of the sand and stone bins. The mixers are each provided with a batch hopper, which is freely suspended from the proportioner panel and a stub hopper rigidly attached to the mixer.

The proportioner panels each consist of a plate 6 ft. square, having three radial gates placed near the bottom, the center one being 18 in. wide and the others 12 in. The floating batch hopper is suspended from the horizontal arms of two bell cranks, mounted on a cam shaft. Attached to the ends of the vertical bell crank arms are ¼ in. wire ropes which, by means of ball-bearing pulleys, pass under the end of a shaft on which three pans are mounted. Stone is drawn through the 18 in. gate by pulling a rope which raises and latches the gate. When the weight of stone in the floating hopper balances the counter weight in the bottom pan, the floating hopper drops slightly and the rotation of the cam shaft releases the latch and allows the stone gate to close. Pulling a second rope opens the cement gate, and the shaft rotates slightly again, when the weight of the stone and cement balances the counter weight in the two lower pans. Sand is drawn through the third gate, the total batch balancing the sum of the weights in all three pans. The original pans have been removed and a series of cast iron weights, similar to ordinary platform scale weights, substituted, making easier the very frequent changes in proportions and affording instantaneous reading of the settings. A batch counter is operated by the bell cranks on each panel. The levers controlling the discharge from the batch hopper and from the water tank are placed close to the three ropes operating the gates of the proportioner panels and the control of the mixer discharge is led up to the operating platform by a chain drive, so that the entire work of charging, mixing and discharging is performed by a single operator for each mixer.

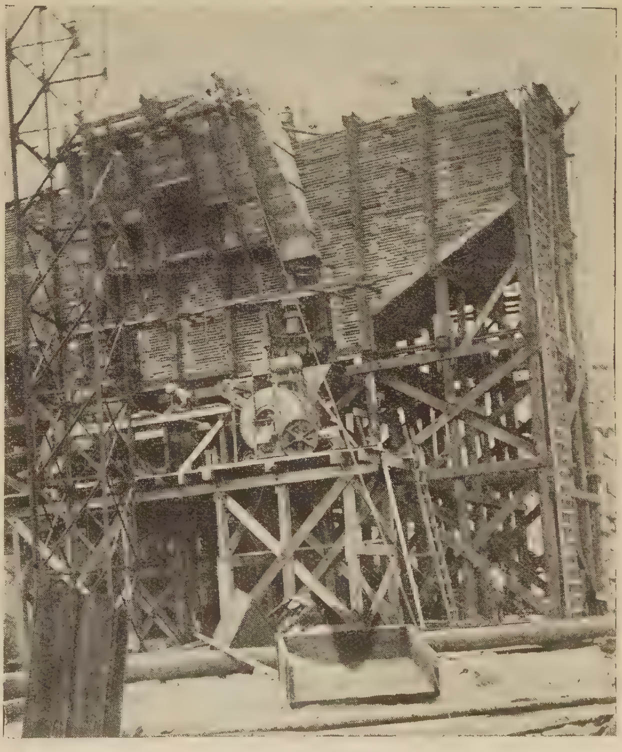

FIG. 2—MIXING PLANT DURING ERECTION, SHOWING SMALL CEMENT BINS HUNG IN FRONT OF SAND AND STONE BINS

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[4] Lakewood Engineering Co., Cleveland, O.

[5] Koehring Machine Co., Milwaukee, Wis.

Concrete discharges from both mixers into a floor hopper at the base of a 180 ft. Insley standard steel tower.[6] This tower is equipped with sliding frame and boom plant, and a fixed hopper at the top. Concrete is delivered through Insley chutes to the forms, the pours averaging about 300 yds. to a form. A Lidgerwood single drum hoist,[7] having a rope speed of 400 ft. per minute, and driven by a 100 h. p. motor, is used. Seventy batches an hour have been poured, lifting the concrete 160 ft. A rehoist tower will be used to place concrete in the southerly cofferdam. From the mixer tower concrete has been spouted 420 ft. Owing to the nature of the crushed stone, chute slopes are generally maintained about 2½ to 1. Stone passing a 3-in. ring was used at the start, but much better results in chuting have been obtained with the 2⅛ in. ring size.

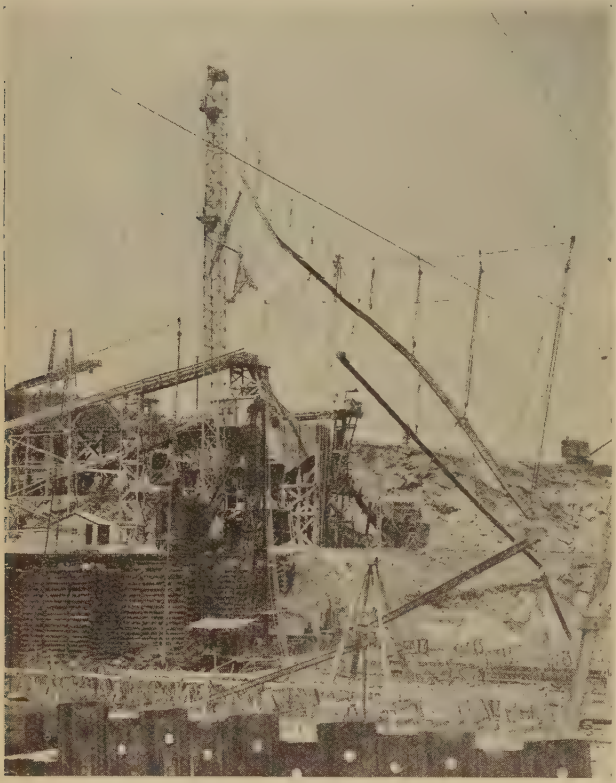

Fig. 3—Completed Plant, Showing Cement House, Stacking Conveyor, Stone and Cement Conveyors, Tracks Over Bins and Chuting Plant

Constant changes in proportions are made, both because of the four classes of concrete in the job and the variation in the crusher run product and the pit-run sand. Very frequent sieve analyses are made, both of the crusher run product and the pit-run sand, with a simple apparatus kept on the mixer operating platform. This apparatus consists of a 12-in. cube box with handles, a ¼ in. mesh screen, and a measuring box so proportioned that each half inch in depth indicates 1% of a cubic foot. The cubic foot box is filled with a sample drawn from the gate, and the contents dumped on to the screen. The amount retained on the ¼ in. screen is measured directly in percentages of a cubic foot. Thus is measured the percentage of fines in the crusher run and the percentage of coarse in the pit-run, and the proper settings for the counterweights, in order to maintain the predetermined proportions of total fines and total coarse aggregate, are read directly from the curves shown in Fig. 4. The percentage of gravel that is coarse in the pit-run sand has varied from 0 to 40, but the analysis can be made and the settings of the counterweights changed in 10 minutes.

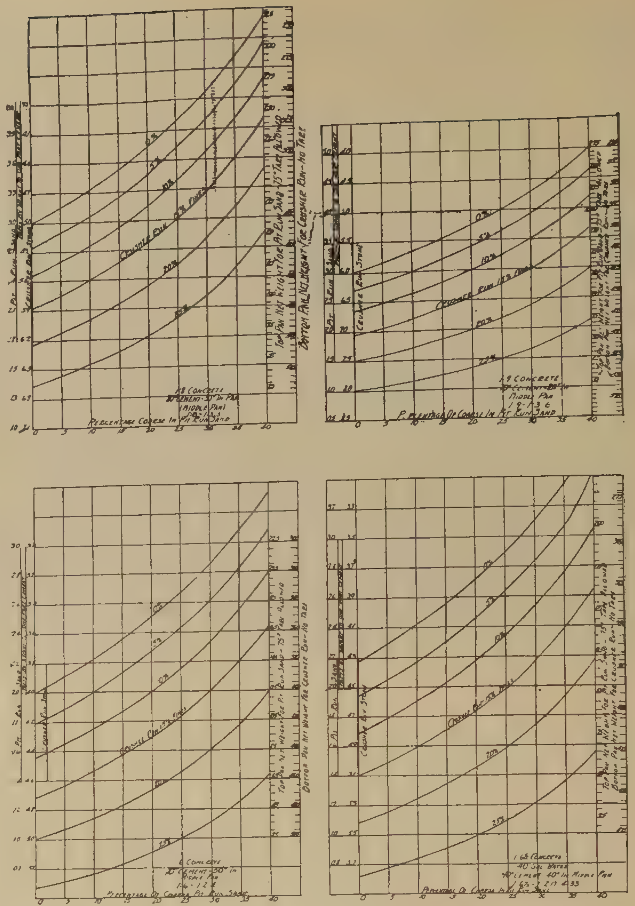

Fig. 4

The personnel of the job is headed by E. A. Little, as manager; Guttorm Miller, as supervising engineer; the writer as designing field engineer, and F. Enander, master mechanic.

Course for Superintendents of Construction

The new one year course for superintendents of construction which is now given in Milwaukee under the auspices of the University of Wisconsin Extension division department of civil and structural engineering has thirty men enrolled. The work is organized on the plan of giving thorough training in the fundamentals and in the practical subjects closely allied with construction work so as to furnish the best preparation for men who desire to become construction superintendents. The main purpose of the course is to train the student in the subjects necessary to equip a construction superintendent with sufficient knowledge so that after acquiring a due amount of experience he will be able to manage and direct successfully the construction of large works of various types. English, mathematics, and studies in the branches of structural engineering, engineering economics and commerce are included in this course. Next year a course for structural designers and builders will be started.

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[6] Insley Mfg. Co., Indianapolis, Ind.

[7] Lidgerwood Mfg. Co., New York City.

Concrete for Mines and Mine Buildings

Some Applications of Concrete in Northern Michigan Iron Mines—Part I

By B. G. Best

The five most notable advances in the practice of mining in the Lake Superior district during the last twenty years are:

The development of the open pit mines of the Mesabi;

The abandonment of the room and pillar system of underground mining in favor of more efficient methods;

The increased use of electricity both underground and on surface;

The replacing of timber as a construction material by steel;

The replacing of both timber and steel by concrete.

This article deals with the last subject, and the purpose is to describe a few of the many uses of concrete in and about the underground iron mines of northern Michigan. No attempt has been made to cover the entire field, but the examples given will furnish an idea of the varied uses to which this material may be put.

In all probably concrete was first used in mining some twenty-five or thirty years ago—and used rather timidly at that—in foundations for light machinery and in boiler settings. From this small beginning concrete has, in the space of a few years, become the standard material for foundations for machinery of all types and sizes—boilers, hoisting engines, air compressors, generators, motors, shop machines, pumps, ore, coal and rock crushers, ash handling equipment, and almost every other kind of machinery used at a mine. The use of concrete in buildings is natural and is nothing more than would be expected, for mine buildings differ but little from other industrial buildings. The modern steel head frame, the development of which has been contemporaneous with that of concrete, is usually built on a concrete foundation. Concrete has been used to strengthen existing steel head frames, and in a few instances reinforced concrete head frames have been built and are giving satisfactory service. Concrete has been accepted as an ideal material for lining shafts, and in some shafts has been used for dividers, end pieces and walls, the entire shaft being constructed of concrete. Underground ore pockets, stations, pump houses, sumps, dams, and air receivers of concrete are no longer unusual.

Some Advantages of Concrete Construction

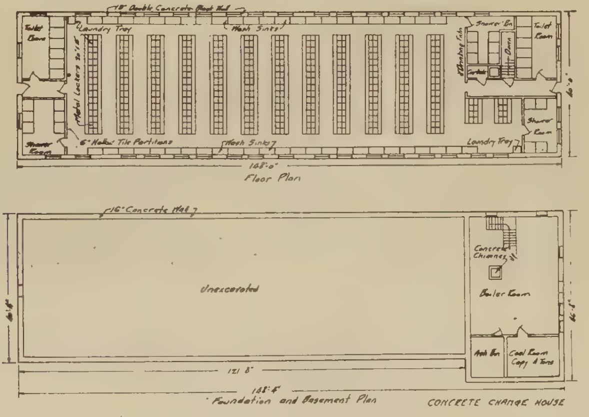
The fireproofing and fire resisting qualities of concrete are too well recognized to call for any comment here. When the disastrous effects of mine fires are understood and considered there is little speculation regarding the value of concrete construction in and about mines. Fire is the mining man's worst enemy. A fire in an office building, change house or warehouse will merely destroy the building and its contents and cause temporary inconvenience. Fires in shops, sawmills and similar buildings are more serious, because they may interfere with the underground work. The effects of a fire in a building wherein explosives are stored is obvious. Should the buildings housing the mine power plant be destroyed, expensive machinery may be damaged to such an extent that it will be necessary to suspend mining operations until the damage can be repaired. That mine shut-downs are expensive, even when no damage has been done, is shown in a recent statement issued by the Anaconda Copper Co., where it was announced that the cost of keeping the company's mines at Butte closed down was in excess of half a million dollars a month.

There is always danger that a fire on the surface will spread to the underground workings, causing extensive damage and possibly loss of life. The old type of timber head frame, saturated with oil and grease, is perhaps more inflammable than any other mine structure. Furthermore, fire in a head frame will prevent hoisting the men to the surface and may quickly spread to the shaft timbering. Fires originating in the underground workings, while more difficult to fight and control, will in most cases afford an opportunity to bring the men to the surface. The financial losses caused by a mine fire may be classified as follows:

1. The value of surface structures destroyed—usually covered by insurance.
2. The value of supplies and equipment destroyed—usually covered by insurance.
3. The cost of overhead until production is resumed.
4. The loss of revenue during the period of idleness.
5. The cost of repairing shafts and underground openings damaged by fire.

Because of the large amount of combustible material necessarily kept on hand at a mine, the ease with which a surface fire spreads to underground workings, and the disastrous results of mine fires, the erection of fireproof structures whenever possible is one of the most important factors in mine plant design.

When the iron ranges were new, and the extent of the ore bodies unknown, nearly all of the mine buildings were of temporary frame construction. As the mines were developed, and production assured, a higher type of equipment became necessary and larger and



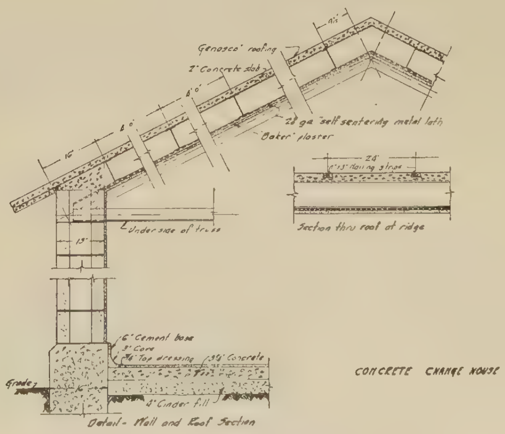


Fig. 1—Concrete Change House, Pabst Mine

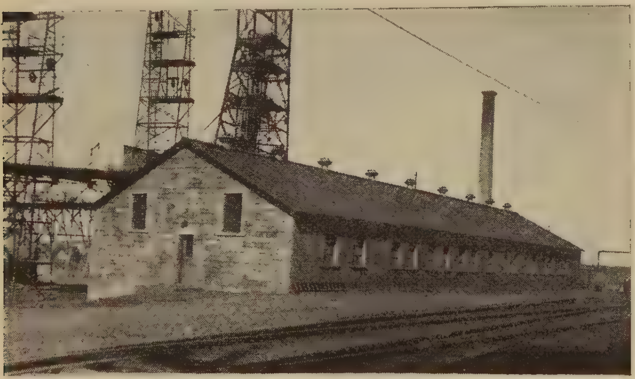
Fig. 2—Roof and Wall Details, Concrete Change House, Pabst Mine

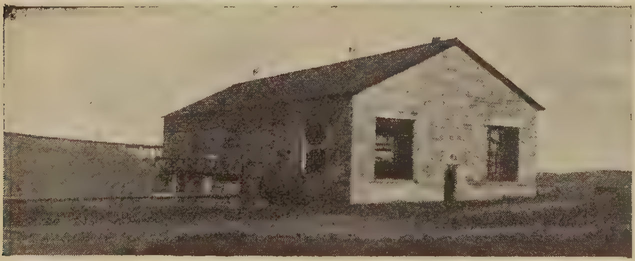
more pretentious buildings were erected. Because of its fireproof qualities, and because in many cases it created a use for waste rock from mining operations and for discarded hoisting ropes, and because the regular mine force could be employed in its use, concrete has been used to considerable extent in the more recent buildings and structures.

In the case of change houses, concrete offers additional advantages. Because of the high temperatures necessary in these buildings, to dry the underground clothes of the miners, the old frame change houses were usually infested with cockroaches and other vermin. In a concrete change house, however, there is almost no place, with the exception of the lockers, wherein vermin may lodge and breed, and a daily washing of the floor with a hose keeps the building clean. It has also been found that in comparison with the frame type, concrete change houses are more easily kept at a uniform temperature, giving better results at a smaller expense.

MINE BUILDINGS—CONCRETE CHANGE HOUSE, PABST MINE

Figs. 1 and 2 show the floor plans and wall and roof construction of the concrete change house recently built by the Oliver Iron Mining Co., at the Pabst mine, Ironwood, Mich. This building, designed to accommodate 400 men, is 40 ft. by 148 ft. in size and one story high, with a basement in one end for the heating plant. The foundation walls are of poured concrete—using waste mine rock—and 16 in. thick. The building walls are 13 in. thick, of T-shaped cement block laid in two rows, with a dead air space between. The roof is supported by the end walls and ten steel trusses resting on the side walls, and spaced 13 ft., 13 ft. 6 in., and 14 ft. on centers. The purlins are I-beams and channels, to both top and bottom of which metal lath was attached. Beginning at one end of the building, the concrete roof slab, 2 in. thick, was poured in 2 ft. sections running from the eaves to the ridge. At the edge of each section a 1 in. by 3 in. nailing strip was placed, to which the roofing was nailed. After the roof slab was poured, heated asphaltum pitch was poured from a kettle and brushed over the roof. A roll of roofing which had previously been cut to the correct length, was brought to the ridge, unrolled, and fastened in place. The underside of the roof was plastered to prevent condensation and heat radiation. Plaster was also applied to the inner surface of the wall blocks, making a light, attractive interior. Partitions of 6 in. hollow tile, also plastered, divide the main floor of the building into a locker room containing 400 metal lockers, 20 in. by 15 in. by 60 in.; 48 wash sinks, and 2 laundry trays; 2 shower rooms for the miners, each containing six showers; one shower room for the bosses, containing four showers; two toilet rooms, and one carbide closet. Each wash sink is equipped with two sprays, from each of which hot or cold water or a mixture of the two may be drawn. The change house is heated by steam, the pipes running under each row of lockers and at both ends, extending to the top of the lockers. The building is equipped with steel sash and wire glass windows.





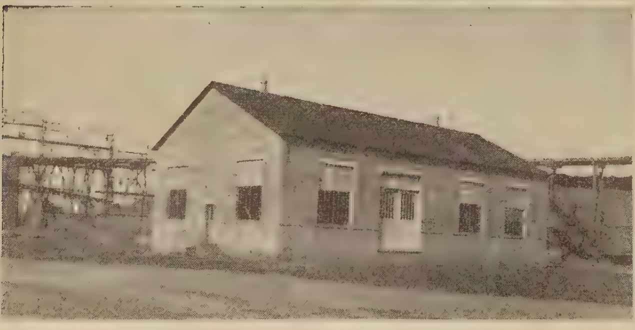


FIG. 3—CHANGE HOUSE, "H" SHAFT, PABST MINE

FIG. 4—ENGINE AND COMPRESSOR HOUSE, "C" SHAFT, EAST NORRIE MINE

FIG. 5—ENGINE HOUSE, "D" SHAFT, EAST NORRIE MINE

A reinforced concrete chimney resting on a footing 6 ft. by 6 ft. by 1 ft. extends to a point 70 ft. above the boiler grate. The inside size of the chimney at the base is 30 in. by 30 in., tapering to 24 in. by 24 in. at the top. The walls are 8 in. thick and reinforced vertically with 12 3/8-in. rods, and horizontally with No. 3 wire hoops spaced 2 ft. center to center. The floor in the main part of the building is a 3¼ in. plain concrete slab, with a ¾-in. thickness of top dressing, making a total thickness of 4 in. The floor is laid on a 4-in. cinder fill. The floor over the boiler room is a 4 in. concrete slab reinforced with American Steel and Wire Co. triangular mesh, supported by T-beams resting on the foundation wall and H-section columns. A reinforced concrete beam over the coal and ash bins supports the building wall at this point. Fig. 3 is an exterior view of the change house.

Similar change houses, though slightly smaller, have been erected at the company's Aurora and Norrie mines at Ironwood.

CONCRETE ENGINE HOUSES, IRONWOOD, MICH.

At Ironwood the Oliver Iron Mining Co. has also erected four concrete hoisting engine houses, 44 ft. by 82 ft., and one combined engine and compressor house, 44 ft. by 106 ft. These buildings are somewhat similar in construction to the change houses described above. The foundation walls are of masonry or concrete, and the building walls of cement block, as in the change houses. There is a full basement under each of the engine houses, enclosing the engine foundations and containing electrical equipment. In these buildings the roofs were finished in the same manner as were those of the change houses, and carried on steel trusses and the end walls of the buildings. The trusses, however, were all supported by steel columns. The basement floors are plain concrete, and the main floors of reinforced concrete, supported by I-beams. Fig. 4 is an exterior view of the engine and compressor house at "C" shaft, East Norrie mine, and Fig. 5 an exterior view of the engine house at "D" shaft, East Norrie mine.

(To be continued in March CONCRETE.)

Street Pavements of Concrete[1]

A Review of the Growth in Popularity of This Type of Construction

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Concrete street pavements, as we know them today, are a development of the last few years. While the total yardage of streets which are today paved with concrete is small compared with some of the older types, the increase in yardage during the last ten years has been by far more rapid than that of any other paving material.

Though the modern high type pavement is of recent origin, there are a few early examples which throw some light on the service that we may expect from the concrete pavements we are laying today. No other paving material has received the study and has been developed with such rapidity as the concrete pavement. As a result of these studies and developments, the present day pavement is in many ways superior to the early examples and we may safely expect better service than has been rendered by th concrete pavements of thirty years ago. A few instances of early concrete street pavements are cited to bring out this point.

In 1892 the city of Bellefontaine, Ohio, constructed a strip of concrete pavement 10 ft. wide and 220 ft. long, on the west side of Main street. During the next two years about 7,300 sq. yds. of pavement were constructed around the public square. This pavement was 6 in. in thickness and of two-course construction. The bottom 4 in. consisted of one part of cement and four parts of bank-run gravel. A 2-in. top course consisted of one part cement and four parts sand, laid off in 5 ft. squares. This pavement is still in use and in very fair condition. There has been some spalling and cracking along the longitudinal joints, but this has not been excessive. Bellefontaine is still building concrete streets, there being 23,680 sq. yds. of streets and 5,380 sq. yds. of concrete alleys now in use.

In 1894 a lane leading to the railroad station in Watertown, N. Y., was paved with concrete. About one-half of this pavement is still in place and in good condition. It is my understanding that the other half was removed, due to its interference with street improvements.

These are supposed to be the first examples of concrete street paving in the United States. From this time on there was little progress made in developing and constructing concrete pavements until in 1909 Wayne County, Michigan, inaugurated a comprehensive paving program and selected concrete as the type to be constructed.

At the beginning of 1909 there was a total of only 445,000 sq. yds. of concrete street paving in the United States. During that year about 325,000 sq. yds. were laid, and this steadily increased until 1916, when approximately 7,400,000 sq. yds. were constructed. During the next two years new construction fell off, owing to war conditions, but in 1919 11,000,000 yds. were laid. This yardage was due in some degree to work deferred during the war, and this condition was reflected in 1920, when slightly less than 9,000,000 yds. were constructed. However, in the first nine months of this year about 8,812,000 sq. yds. of concrete street paving have been contracted for and the indications are that it will well exceed 10,000,000 sq. yds. by the end of the year. At the present time there are upwards of 65,000,000 sq. yds. of concrete streets in service in the country.

In the ten states in the vicinity of New York City there are a total of 464 towns and cities which have constructed concrete street pavements. One hundred and ninety of these constructed their first concrete within the last two years, indicating the rate at which the use of concrete for street paving is increasing. At the end of 1911 100,000 sq. yds. of concrete streets had been constructed in this district. At the end of 1918 this had increased to 3,000,000 sq. yds. by the steady increase from year to year. The period between the first of January, 1919, and the end of September, 1921, showed a higher rate of increase, the yardage contracted for during this period approximating 7,500,000.

In the New York district there are 21 cities of 50,000 population, which have constructed concrete street pavements more or less extensively. Among these are many pavements as wide as 75 ft. A notable example of this is the east and west ends of Western avenue, in Lynn, Mass., which is 60 ft. in width, and was consrtucted in 1914.

There are well over 100 cities in the United States which now have more than 50,000 sq. yds. of concrete pavement. The most notable examples are Sioux City, Ia., and Kansas City, Mo., each with over 1,000,000 sq. yds. of concrete pavement. Of the 100 cities, about 40% have more than 100,000 sq. yds. each.

Sioux City started to construct concrete streets in 1911, and since that date has put down this type to the practical exclusion of all others. These pavements are on grades as high as 16%, and have given perfect satisfaction to all classes of traffic, including the horse-drawn vehicle. The satisfaction of Sioux City's taxpayers with concrete street pavement is primarily due to the fact that their maintenance has been almost nothing, although some of the first pavements were only 5 in. thick and constructed of a lean mix. In 1916 a survey of about 6 miles of pavement in a typical section of this city showed cracking in only 1% of the slabs, although some of the pavement was then over five years old. Moreover, many of these cracks were so minute that they could not be filled with tar. These results were achieved because careful attention had been given to the design and construction.

Kansas City, Mo., has constructed considerably more than 1,000,000 sq. yds. of concrete pavement, and has had very satisfactory experience with them, although some of the first pavements put down were of a lean mix, due to the intention of using the pavement as a base for an asphalt top at a later date. In very few instances have these been covered, even though the pavements have been in use for nine or ten years. No attempt was made to cure most of the old work, and traffic was allowed on the pavement within four to ten days. These pavements have required very little maintenance outside of the filling of cracks with bituminous material. In 1918 Kansas City started to use a 1:2:3½ mix, and carefully improved their specifications and workmanship. A notable example of the service this city has obtained from a concrete pavement is to be found on McKee street. This was originally intended for a concrete base, but the results were so satisfactory that it has never been covered.

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[1] Address at City Paving Conference, under auspices of Engineers Club of Philadelphia, Oct. 20-21, 1921.

Mason City, Ia., constructed 6,000 sq. yds. of concrete streets in 1909, and during the next seven years constructed a total of 160,000 sq. yds. During this period the city spent $1,734.40 to maintain this yardage. Practically all of the ten miles of street pavements in the city during this time are of two-course concrete, 7 in. thick, and still in excellent condition. This city is still continuing to lay concrete pavements.

A two-course concrete pavement was constructed on Chapel stret, New Haven, Conn., in 1908. This is 3,062 ft. in length and consists of a 5 in. base of 1:3:4 concrete, with a 1¾-in. wearing course of 1 part cement and 1½ parts of crushed trap rock screenings. Practically all of the coal consumed in this district is hauled over this pavement in heavy steel tired vehicles. During the 13 years that this pavement has been subjected to this heavy traffic, the wear has been so slight that the scoring, which was placed on the surface when the pavement was laid, is still plainly visible over practically the entire area of the pavement. The condition of this pavement today is excellent.

In 1916 Sheridan road, through Kenilworth, Ill., a residential section of Chicago, was paved with concrete. This is 40 ft. wide, 3,500 ft. long, and consists of a lower course 5 in. thick at the curb and 8 in. thick at the center, of a 1:2½:4 concrete. The wearing course is 2 in. thick, of 1:1:1½ concrete, giving a total thickness of 7 in. at the curb and 10 in. at the center. The coarse aggregate used was crushed granite. This pavement is reinforced with No. 27 triangle mesh steel, which was placed between the base and the wearing course with ½-in. round steel bars, 14 ft. long, on 12 in. centers, 2 in. above the bottom of the base slab. This latter reinforcing was specified with the intention of reinforcing the slab over a large sewer placed in the center of the street. This pavement is now in excellent condition and the maintenance has been negligible. Sheridan road is located along the North Shore lake front of Chicago, and carries a large volume of motor traffic.

CONSTRUCTION

One of the first facts to drive home to the engineer who designs concrete pavements is that paving concrete has several points of difference from structural concrete. Probably the greatest difference is that in paving, concrete's compressive strength is not the prime consideration as it is in structural work. While strength is important, the resistance which a concrete surface will offer to abrasion is of greater concern. It is possible with commercial materials to get concretes that will develop abnormal compressive strength, and at the same time have little resistance to the abrasive action of traffic. This is particularly true with sands which are dirty or which are made up of grains that are themselves unstable. Under abrasion these unstable grains break down into their component parts, causing pitting and scaling of the surface.

The sand therefore is the prime consideration. It is necessary that the sand be selected with care so as to produce a mortar of high abrasive resistance. With a good mortar, it is not essential that the coarse aggregate be of unusually high quality. Excellent pavements have been built with a coarse aggregate whose French coefficient was as low as 5, but the sand in each case was of first quality. It is recommended, however, that if high quality coarse aggregate can be readily obtained, that it should be used for the wearing surface of concrete pavement. There is no objection to a mortar top on a concrete pavement, providing it is a *good* mortar top and not an accumulation of the objectionable materials in the aggregates which have been brought to the surface by excess manipulation.

Successful paving mixes range in practice from 1:1½:3 to 1:2:3 and 1:2:4. This variation is due to the difference in material, soil and climatic conditions found in the several states. Pennsylvania has standardized on a 1:2:3 mix, because it more nearly meets local conditions and produces a slight excess of mortar which the State Highway Department believes to be essential in order that the full wear resisting qualities of a concrete pavement may be developed. This mix also produces an easily worked concrete, which is a long step towards getting a homogeneous slab under field conditions.

It has been demonstrated that the water ratio has a distinct bearing on both the strength and the wear resisting qualities of a concrete. For that reason the water should be kept as nearly ideal as field conditions will permit. Stiff mixes in general produce concretes of great resistance to wear, but are difficult to place properly in a road slab. Homogenity of the slab is of course of great value, and should be obtained at all costs. It is not, however, necessary to resort to wet or slappy mixes to produce slabs of the desired uniformity. A plastic mix is easily placed and develops a high percentage of the possible abrasive resistance.

There has been a wide variance in the different views regarding the proper thickness of slab. It has been held that thickness and reinforcement are related, in that the percentage of reinforcement should increase as the slab thickness decreases. It seems more logical that this is not the case. The probable function of slab thickness is to produce a mass which will resist the impact of traffic due to its inertia. It has been found that under light loads and traffic, a slab thickness of 6 in. has given good results. For the average traffic of the town or small city, 7 in. is recommended, while for the heavy volume and weight of traffic found in the larger centers of population 8, or, in extreme cases, 9 in. should be used. There seems to be no logical reason why this thickness should vary between the curb and the center line. City traffic is well distributed. The greater width of slabs exclude the factors which govern the thickness of rural highways.

The amount of reinforcement to be used is a function of the stability of the sub-grade. In stable, open soils it would seem that pavements could be laid without reinforcement. Many successful examples of unreinforced concrete streets are to be found throughout the cities of the Middle West. Excavations for sub-service structures, however, seriously affect the stability of the sub-grade in many instances. In order that a pavement may act as a unit and if subsidence occurs, that this may be as uniform as possible, some reinforcement is recommended in all streets. In unstable soils, or in the presence of unfavorable drainage conditions, the proper amount of reinforcement may run as high as 10 lbs. per sq. yd.

It has been found that the use of light wire mesh, weighing say 25 lbs. per hundred square feet, does not materially reduce the amount of cracking, but it does hold together the edges of the cracks which do form, so as to lengthen the life of the pavement and reduce the maintenance expense. It has been observed that meshes weighing 50 lbs. per hundred sq. ft. and over do minimize cracking in stable soils, and at the same time possess all the advantages of the lighter mesh. Very successful work has been done with weights of metal from 60 to 80 lbs. per hundred sq. ft. It is believed that for main thoroughfares, where there will be considerable opening of the pavement and attendant disturbance of the sub-grade, that these weights will prove economical. Over 80 lbs. it is possible to get a close enough spacing of light bars to produce a very effective reinforcement. The use of bars for the heavier weights will in most cases prove to be an economy.

On wide streets it will be necessary to construct the pavement in two operations, that is, with a construction joint on the center line of the street. A form is set longitudinally on the center line and one-half the pavement is constructed for, say a city block. The form is removed and the other half placed, using the concrete of the first half in lieu of a form. This joint is not apparent on well constructed streets and adds little if any to the construction or maintenance costs.

Transverse expansion joints should be provided to take care of movements in the slab, due to thermal and moisture changes. These joints should be spaced from 100 to 300 ft. apart, and should in general be spaced closer on work poured late in the fall and during cold weather than on work placed in the heat of the summer. The joints are formed of one-half inch sheets of pre-molded bituminous material. Their installation gives little trouble to a skilled crew of concrete pavement workers, and if properly installed do not adversely affect the riding quality of the pavement.

Concrete after being placed is brought to the true contour by means of a heavy template or screed. Weight is essential in this tool to produce an even riding surface. The mass is further compacted and excess water removed by means of a light hand roller, which is moved back and forth across the pavement in a transverse direction. The final surface is given by means of a canvas belt or light board, the belt or board being about 10 in. wide and 2 ft. longer than the width of surface belted. The belt is drawn along the pavement longitudinally with an accompanying side-to-side motion.

Proper curing is essential to the life of a concrete pavement. The concrete should be kept wet for a period of at least 10 days. To accomplish this it is usually necessary to cover the surface with earth or straw, which is kept soaked with water. Under favorable conditions, pounding of the surface can be successfully practiced.

A street should be closed to traffic for from 14 to 21 days after placing, depending on the weather conditions. It is possible that this time can be cut in half by the use of hardeners, but experiments in their use for paving concrete have not sufficiently progressed so that the use of accelerateors or hardeners can be unqualifiedly recommended at this time.

REPAVING

There are numerous examples of old concrete bases being resurfaced with paving concrete after the original covering had deteriorated beyond repair. Three notable examples, which may be cited, are as follows:

In Kirkville, Mo., a bituminous top coat was laid on a portland cement base in 1907. This pavement gradually deteriorated until it was decided in 1917 to repave the street. This was accomplished by placing a 4-in. concrete slab, reinforced with 48-lb. triangular mesh, which was laid on the old base.

In about 1899 East Bridge street, Oswego, N. Y., was paved with a bituminous surface on a Rosendale cement concrete base. In 1919 the bituminous material was removed and the old base resurfaced with 4½-in. of concrete, reinforced with 25-lb. rectangular mesh. Similar treatment was given South Seventh street, Terra Haute, Ind. This pavement was resurfaced with from a 3 to 4-in. layer of reinforced concrete in 1918. (Wayne County, Michigan, resurfacing was described in CONCRETE for June, 1916, and in the December, 1921, issue was reference to the wear of the job.—Editor.)

Old concrete pavements, or old concrete bases may be very cheaply resurfaced with a moderately thin layer of reinforced concrete, and by taking precautions to prevent the new concrete from adhering to the old, the base may be resurfaced, at small cost, after the wearing course has outlived its usefulness. It is impossible to say how long this will be, as there are many examples of concrete pavements being in perfect condition after 10, 20, or even 30 years of hard usage. There are some examples of small stretches of concrete pavements in Europe which are from 30 to 50 years old, and are still in good condition. The contention will be met with that concrete pavements do not readily lend themselves to repair when once they become worn. This can be met by resurfacing along the line suggested above.

Surface course, or resurfacing concrete, can be prevented from adhering to the base by an application of a paint coat of bituminous material. A pavement laid in this manner presents no new problems. It can be repaved and openings in the pavement can be closed in the same manner and with the same ease as with any other type of pavement which consists of a surface course on a concrete base.

OPENINGS

One course concrete street pavements can be readily and economically repaired when it is necessary to cut through the pavement for the repair or installation of sub-surface structures, such as gas or water pipes. Macon, Ga., has been very successful in this, having closed upwards of 300 holes cut through their concrete street pavements with concrete in such a way that it is very difficult to locate the patch. The excavation is carefully backfilled and thoroughly compacted to prevent settlement. The pavement is then trimmed sufficiently to secure a vertical edge, so that there will be no feathering of spalling about the edges of the new concrete. A 1:2:3 mix is used for patching, as this is the mix used in the pavement, and care is taken to secure aggregates similar to those used in the original pavement. The cut-out section is filled with from ½ to ¾-in. higher than the pavement's surface and immediately tamped. After 15 to 20 minutes it is again tamped. This action is repeated at like intervals, depending on weather conditions, untli the concrete is thoroughly compacted and has lost its plasticity. The patch is then finished by hand float, care being taken to get the surface even with the old pavement. Macon has about 16 miles of concrete pavement, ranging from 30 to 50 ft. in width, which has been maintained at a cost of $3.00 per mile per year.

See Cost Analysis of 5 Wisconsin Roads—page 81.

Importance of Road Finish

Methods of Control[1]

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Apparently a strong mental tendency is to disregard the obvious and seek the remote. Perhaps this is because the obvious is often an aggregation of trifles, while the remote may be striking, stupendous. Certain it is that almost any more obscure cause may be heard given for the success or failure of any road, than the simple one of surface finish. Yet, I believe that in the concrete road economically designed, the life of the pavement depends as much upon the surface finish as upon any other factor.

We know now that impact is the great cause of destruction in our pavements. Impact is the bumping or banging of one object upon another. As I roll a smooth cylinder along a smooth table there is practically no impact, but let ridges appear in the table, and as the cylinder bumps along over them you get a series of impacts that, if the cylinder be heavy enough and rolled often enough, will soon wear out the surface and damage the structure.

That is analogous to what is happening to our roads. If the wheels of vehicles are smooth and the pavement surface is smooth, there is no damaging impact from traffic. The road lives even though it be weak in proportion to the volume and weight of traffic it must carry. But let surface irregularities develop, and no matter how strongly built, the whole pavement soon shows the effects of wear. We build our roads on an average to withstand a pressure of 800 lbs. per linear inch width of tire. Yet, if an unevenness in surface of only 1/4 in. occurs, the impact of one rear wheel of a five-ton truck may exert an impact pressure upon the road of 20,000 lbs. Under such pressure, the unevenness becomes a depression whose edges spall and break, causing further impacts, and more depressions, until the pavement is badly damaged.

In order to lessen impact, we must get and keep smooth surfaces. How can we do it? Close scrutiny of work and infinite attention to detail are essential. Then there are certain general remedies suggested by the general causes of unevenness, specific remedies being tried by different states or on different jobs, and different methods of work and machinery.

There are five general causes of unevenness in the pavement surface:

1. Foreign materials in the aggregate, which, failing to amalgamate, are busted, leaving holes and depressions.
2. Non-uniform aggregates, which cause inequalities in wearing resistance to traffic, and subsequent depressions in the weaker places.
3. Poor workmanship in striking off and finishing.
4. Cracks, longitudinal and transverse, due to frost action, changes of temperature or unequal bearing power in the subsoil.
5. Uneven joints, perhaps the most common cause of surface trouble, due often to the piling up of joint material or to difference in elevation of slab surface.

The general remedies for surface unevenness are as obvious as the unevenness itself, and therefore, perhaps, as often neglected—strict specifications exacting good material and good workmanship. More and more we are getting these on paper. The problem is their application to the job, because there is where the human element enters. How solve the personal equation between engineer and contractor? I wish that sometime we might have fuller discussion on this point. The answer is at once made that the relationship should be one of cooperation and mutual endeavor toward a common end—the best possible road. But as long as private profit outdistances social welfare as an aim in our economic life, just so long are we often going to have the contractor trying to get all he can out of a job, while the engineer is trying to make him put all he can into it. So sometimes the letter of the specifications is violated, and frequently their spirit. When all engineers know their job so well that they can show contractors easier and better methods of doing their work, and when all contractors regard highway work as a legitimate industry and not a financial gamble, then we shall have that adherence to specifications that will insure good work and smooth surfaces.

Three other general methods of preserving good surface finish once it is obtained are the use of steel reinforcement, the division of the road longitudinally, and the wider spacing of joints with the use of dowels.

The advantages of steel reinforcement are that it gives the road greater bearing power and greater resistance to frost action and that it offsets irregularities and weaknesses in the subsoil. By helping to preserve the integrity of the pavement, it minimizes any tendency toward cracking, which is of course a cause of surface unevenness.

The division of the road longitudinally increases its beam strength about four-fold. Observation reveals that longitudinal cracks are not found in slabs nine and ten feet wide, though we have all encountered them in slabs beyond that width. The reason for this difference is still conjectural, but until it is ascertained we would do well to be guided by results hitherto obtained, and build our concrete roads in two longitudinal sections.

Transverse joints being a prolific source of trouble, it is well to diminish their number as far as possible through the use of the longer slab. This wider spacing of joints becomes feasible through the use of steel reinforcement to meet the temperature stresses of the slab. The use of dowels gives stability to the joints and holds the surface even. The submergence of joints an inch below the surface has proven unsatisfactory. Devised at first to secure a smooth surface and permit the use of a finishing machine, it seemed admirable until subsequent expansion crowded and crushed the concrete above the joint material, leaving a badly ravelled and spalled joint. The best method that I have found of of making a joint is to submerge the joint material until after the screed or finishing machine has passed over it; then to lift the joint material slightly above the surface with long fingered tongs; then to finish the joint with the split float or split roller, rounding the concrete next to the joint material with an edging tool.

Specific application of these general principles is found in the requirements of such states as Delaware, Pennsylvania and New York. In these states, and in others, the specifications exact good workmanship by allowing a maximum of only 1/4 inch depression in ten feet of pavement tested with a straight edge. The use of the straight edge on green concrete indicates depressions to be rectified and insures good results. These states specify materials with such precision as almost certainly to preclude the use of foreign materials in the aggregate or of non-uniform aggregate. They design the roads so as to minimize the danger of movement in the slab and resulting cracks. And they give special attention to the placing of joints and to the suitability of the machinery in use.

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[1] Presented at the Convention of the American Road Builders' Association, Chicago, January 19, 1922.

All of these precautions were taken on the road built last summer in Old Bennington, Vermont, by the Fred T. Ley Co., and so far not the slightest indication of any surface unevenness has appeared on it. This tends to support my belief that we are going to be able to build roads within necessary financial limits that under the traffic permitted by law will be practically indestructible.

The actual method of finishing is of course important in securing a smooth surface. Some road builders prefer to use the finishing machine with the roller and belt. It is essential that the roller be light. A too heavy roller pushes the crown out of the pavement, and spoils the surface. Most specifications call for a weight of from 12 to 15 pounds per foot length. Some builders omit the roller, using only the machine. My own experience indicates that the roller helps. One advantage of the finishing machine is that a dryer concrete can be used with it, which gives greater strength to the pavement. It also gives more uniform results than can be obtained with a green gang, and seems in general more fool-proof than the hand method. Still, many prefer to strike off with the hand screed, using the roller and belt. This has the advantage of making one less piece of plant to get out of order and where a heavy screed is used in the hands of competent workmen it gives as smooth a finish as the finishing machine.

With either method the board belt gives unquestionably the best finish. The bow belt however can give good results. Proper belting takes off not only the water, but also the clay loam, laitance, etc., that tend to form scale on the surface.

I have tried in this paper to bring to your attention only the salient features in securing surface smoothness in the hope that a hasty summary might help to bring practice and theory closer together so that theory might receive fresh impetus to discover the something new on the subject that I have not been able to find and tell you.

Winter Work on Wayne County Roads

The Wayne County (Michigan) Highway Commission is doing considerable winter concrete work this year, chiefly to relieve unemployment, and because very satisfactory bids were secured. These considerations, and the fact that the commission is able to keep its best men, the cost of the work is low, being only slightly higher than that of summer work.

A retaining wall on the River Rouge, near Dearborn, the foundations for the Fort street and Jefferson avenue bascule bridges over the River Rouge, some grade separation work on the Telegraph road west of Michigan avenue, and two bridges between Northville and Plymouth, are the projects under construction.

Concrete is not placed unless the temperature is above 20° F. As most of the work is of considerable cross-section, and in the bottom of pits where there are no circulating air currents, no protection has been necessary. One footing, about 2½ ft. thick, was protected by letting in enough water to cover it immediately after pouring it. It is expected that before the winter is over some work will have to be protected. This will be done by covering with canvas and admitting live steam.

The key men of the road organization are kept employed during the winter by patroling the roads and seeing that small defects are repaired promptly. They also have charge of snow removal. Caterpillar tread tractors equipped with snow plows are kept in farmers' barns at strategic points, and the men in charge have the names of a crew that can be called out at a moment's notice. The minute the weather bureau notifies the commission of an impending snowfall, these men get ready and have the roads cleared for traffic even before Detroit city streets are clean.

The commission has succeeded in having the legislature recognize tree planting along the roads as one of its proper functions. This work has required the services of a number of men this fall and winter. The cost is charged to maintenance. The state pays 50 per cent of the cost of such work on state highways.

LEBANON MOUNTAIN ROAD OVER THE RIDGE OF THE BERKSHIRE HILLS, IN MASSACHUSETTS

Lebanon Mountain Road

Concrete road building began in the middle west and spread both ways. The east was most conservative—New England by tradition especially so. Concrete roads were rapidly displacing the old stone roads, so quickly rutted, so costly to maintain, in many states before Massachusetts took the concrete road seriously. This gives particular interest to methods displayed in the construction of the Lebanon Mountain road, a part of the Pittsfield-Albany route over the ridge of the Berkshire Hills. This piece of concrete lined with other concrete highways across into New York state.

A Federal Aid road, it was built for the Massachusetts Department of Public Works, Division of Highways and the United States Department by C. B. Lindholm, Pittsfield Mass. Most of the work was done at a time late in 1919 and in 1920 when materials were hard to get owing to railway embargoes. Two miles were built in 1919 on a heavy stone sub-base. In 1920 progress was slow until August when a mile was built in 17 days—a record in Massachusetts.

In September, 1920, a stretch only 3300 ft. long near the center of the job remained to be placed. Conditions were such however, that closing this short section would have made necessary a detour of nine miles over bad roads, and it was decided to build the pavement half-at-a-time for this distance.

Using the same equipment as for the full width roadway, the contractor was able to maintain a good output on the nine-foot or half-width strip, the record day's run being 663 lineal feet.

The two longitudinal slabs were keyed together by the construction of a notch along the center edge of the first strip, which was filled when concrete for the second strip was placed against this edge. A triangular piece, obtained by sawing on the diagonal, a 2 x 2, was nailed along the face of the inner form, to make the notch. In the hope of eliminating future projection of one slab above the one adjacent.

Through the use of a telephone system traffic was kept going night and day over the single track route past the mixer with a minimum of delay. Two 12-hr. shifts of three guards each were used. The guard stationed at one end of the section under construction would telephone the man at the other end that ten, twenty, or any given number of machines were coming through. All traffic at the other end would then be held up until the specified number of machines had passed by and the process then reversed. As many as 300 vehicles an hour passed over the road while the concreting crew was at work.

A strong but light fence proved an effective barrier along the center line. The bottom rail placed along the inner edge of the curing slab was of 4 x 4 or 2 x 6 pieces of old guard rail. Posts 30 in. long cut from short or poor pieces of 4 x 4 or 2 x 6 guard rail stock were fastened, at 12 ft. intervals to the bottom rail. The top rail of the fence was made of 7/8 in. by 6 in. by 12 ft. boards and the same material was used for braces which ran from the tops of the posts to stakes driven just outside the pavement. The guard rail stock was not injured by this use and there was a high salvage value for the 7/8 in. lumber.

Several types of stone drains and sub-bases were installed on different parts of the work. For 2700 feet at the east end of the job the old macadam was simply loosened and reshaped. For the next 2400 feet the macadam was removed and a six in. layer of gravel spread in its place. Then on the following 6600-ft. section the existing 15-ft. roadway was widened to 18 feet with gravel and a three-inch layer of that material placed over the old surface. The gravel shoulder to the depth of this 3″ layer (9″ total) was extended out horizontally to meet the side slope. For the remainder of the distance the macadam had been placed over an old stone V-drain and this was widened to 18 ft. At 50 ft. intervals, a trench 4 ft. wide was cut through the shoulder on the down hill side and backfilled with stone in order to give a good outlet for any water accumulating in the V-drain. The shoulders for the entire length of the job were gravel or old macadam 3 ft. wide.

On Lebanon Mountain it was impractical in places to disturb the existing bank on the uphill slope, as that would have meant removing a great quantity of earth and rock. Since there was no room for the standard open ditch under the circumstances, a stone-filled drain was constructed for more than 1200 ft. This was located just outside of the concrete slab and was 3 ft. wide by 4 ft. deep. A six inch layer of gravel was first placed on the bottom of the trench and then as stones were thrown in, the gravel course was extended up the sides. Stones from four in. in diameter to the smallest obtainable were used, with the small stones placed on top. Culverts every few hundred feet furnish outlets under the pavement to the down hill side.

Most of the Pittsfield-Hancock road overlies a heavy clay.

Mr. Lindholm's equipment for the concrete work consisted of a three-bag Lakewood boom and bucket paving mixer and a Koehring mixer loader. Trap rock was brought in by rail from Westfield, Mass., and was unloaded into bins by a special car unloader and then hauled by trucks to the sub-grade. Knickerbocker cement was used. As many as twelve trucks and one hundred and twenty men were employed on the work at a time.

The job included removal of 10,000 yds. of earth, placing of 3,000 yds. of stone filling and 9,000 yds. of gravel filling for sub-base. 3,000 cu. yds. of macadam were excavated from the old road-bed and placed upon the present shoulders. The concrete for the road slab required the use of 15,000 bbls. of cement, 12,000 tons of trap rock and 5,000 cu. yds. of sand.

It is 4.45 miles long, 18 ft. wide. The work was done under the supervision of J. A. Johnston, Springfield, division engineer for the Massachusetts Department of Public Works, and G. A. Curtis, Pittsfield, resident engineer.

Steel Ball Test —Fatigue

The load required to press a steel ball into the surface of a material is a good index of the general strength qualities of some materials. In the form of the Brinell test it is used for testing steel, and it is also used for wood. In recent experiments made by the Purdue University laboratory for testing materials, in collaboration with the Bureau of Public Roads, the test has been applied to the surface of 1:2 mortar slabs, and the results seem to indicate that it will be valuable as applied to mortar and concrete, as well as other materials. The following is abstracted from a Bureau publication, *Public Roads:*

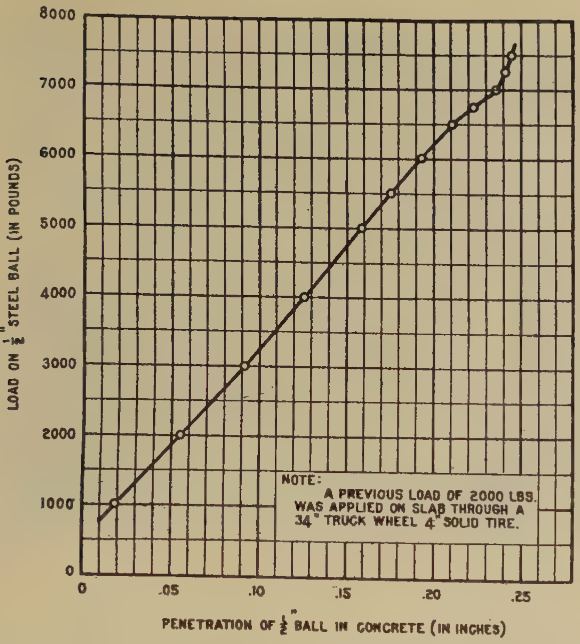
The apparatus, which is very simple, consists of a steel ball ½ in. in diameter and a steel plate 2 in. square by ¼ in. in thickness, with a hole ½ in. in diameter through its center. The plate, with the ball in the hole, is placed on the surface of the mortar slab, and a load is applied to the projecting ball through the moving head of a testing machine, a jack, or any other convenient means.

When the load is applied the ball sinks into the mortar or concrete, the resistance gradually increases with the penetration, until the ball has been driven into the surface to a depth equal to one-half its diameter, when the head of the testing machine or the jack bears on the plate and a sudden increase in resistance is indicated. This event marks the completion of the test and the load when it occurs indicates the strength of the surface of the mortar.

The test is being used in the Purdue laboratory to study the effect of wheel loads on the surface of mortar slabs. A 34-in. truck wheel, with a 4-in. solid tire, is pressed on the slab with a load of 1,000 lbs. The wheel is then removed to a different place on the slab and pressed on with an increased load. In a similar manner several increments are added to the load and each time the wheel is moved to a different part of the surface. The ball test is applied to the parts of the surface subjected to each load, and the effect of the increase is indicated by the loads required to force the ball into the surface. The test has been applied thus far to mortar slabs 7 and 28 days old with similar results. In each case the load required to force the ball into the slab decreases with increase in the load applied by wheel.

The correct interpretation of the results of the tests has not been determined; and before it can be standardized and applied for practical purposes, it will be necessary to ascertain the effect of moisture, aggregate, and speed of test. It seems possible, however, that the test may be useful in a number of different ways.

The simplicity of the apparatus required suggests that it might be used as a field test to indicate when concrete in roads or structures has reached a satisfactory stage of curing so that traffic may be permitted or forms removed. The test



Curve Showing Load Applied and Corresponding Penetrations in a Ball Test, Indicating by the Sharp Break the Point at Which the Ball Penetrated to One-Half Its Diameter

might be applied to concrete roads for this purpose by employing a hydraulic jack and using the weight of a truck to supply the reaction to the jack. Its use may also throw some light on the question of the action of long continued traffic on a concrete road.

It will be recalled that the report of the Bureau of Public Roads on highway construction in California showed that specimens taken from roads of long service were weaker in compression than specimens taken from roads of more recent construction. This report was digested in Concrete for July, 1921. The same issue contained an article by Prof. Duff A. Abrams, explaining this by the fact that the recent roads were built of a better concrete than the earlier roads.

Fatigue of concrete under many loadings is being studied by direct laboratory tests conducted by Clifford Older, of the Illinois State Highway Commission; Dean A. N. Johnson, of the University of Maryland, and the Purdue laboratory for testing materials. Mr. Older is applying repeated loads by the passage of a truck wheel over the ends of projecting cantilever beams. Dean Johnson is bending a pair of beams by means of a cam between them. At the Purdue laboratory a concrete beam is bent back and forth, bringing about a reversal of stresses through the medium of a bracket attached to one end. Loads are applied alternately to the opposite ends of this bracket. Results obtained so far show that concrete will rupture under a repeated load that is less than the once-applied load required to break it. The same extension is reached in each case. A beam of 1:2 mortar, 28 days old, subjected to reversals of load at the rate of 10 per minute, cracked at 112,400 reversals and broke at 144,825 reversals of a 70-lb. load. A similar beam broke under a once-applied load of 140 lbs.

New Concrete Road Standards will be up for consideration and discussion at the American Concrete Institute Convention, Feb. 13.

Concrete Highway Maintenance Truck Used in Kern County, Cal.

Maintenance Truck Carries Materials and Mixer

A highway maintenance truck recently placed in operation in Road District No. 4, Kern county, California, is equipped with combination material bins, and a rotary concrete mixer driven by auxiliary shaft from the transmission.

The bins are built of steel and have a capacity of 1,000 lbs. of cement, 1 cu. yd. sand, 2 cu. yds. gravel or rock, with gravity feed from all bins, controlled by hand-operated gates, to mixing apron. The cement compartment has a steel cover, which is water tight, protecting the cement against moisture.

Water is carried in a 150-gal. steel tank between the bins and the mixer, and may be withdrawn by gravity or under air pressure. There is a centrifugal pump with self-priming device and suction hose for filling the tank from wells or streams.

The concrete can be placed directly from the mixer, as shown in the accompanying illustration, or it can be wheeled into place with the large steel wheelbarrow carried on the rear of the truck.

Pneumatic jackhammers are used to break up the damaged places, and pneumatic air jet to blow out refuse, and chipping guns are used in chipping out cracks.

Compressed air is supplied by an air compressor 6 in. by 6 in. twin cylinder operated by belt from forward drive shaft, and has a capacity of 80 lbs. per minute, and a large air receiver located just back of the cab on the right side of the truck.

Stanley Able, chairman of the Board of Supervisors of Kern county, California, is partly responsible for the development of this idea.

The equipment was designed and built for the Board of Supervisors of Kern county by Fageol Motors Co., Oakland, which will put this equipment into quantity production because of the excellent results obtained with this first equipment.

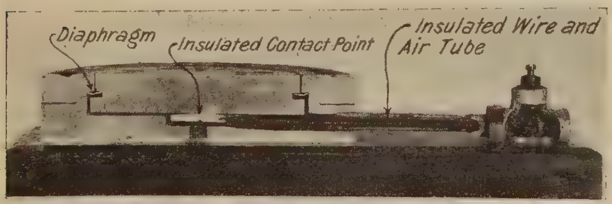
The truck has other miscellaneous equipment used in road maintenance.

What Happens to Road Slab Under Traffic Load

In experiments to find out what thickness of roadbed should be constructed for various traffic requirements on different soils, the federal road bureau has devised an interesting instrument which shows what happens to roadbeds.

To determine the pressure transmitted to a roadbed through an overlying surface, the cell is embedded in the subgrade before the surface is laid, so that the upper surface of the cell will be in contact with the lower surface of the pavement. Pressure applied to the pavement is transmitted to an inner disc suspended within an outer disc by means of a thin copper diaphragm. The pressure transmitted to the inner disc forces it against the insulated contact point, and thus an electric circuit is completed which lights an incandescent bulb in the instrument case. Compressed air is admitted through a pipe and brought to bear on the under side of the inner disc in measuring the pressure. Gradually the pressure is increased until it becomes sufficient to overcome the outside pressure and the inner disc barely moves. When this point is reached the electrical contact is broken and the light in the instrument case is extinguished. The observer, at the instant the light goes out, notes the air pressure recorded on the dial. This pressure is multiplied by the area of the inner disc in square inches and is equal to the pressure applied to the outside of the disc.

The device primarily measures, at desired distances, how the weight of traffic is distributed to the soil through the roadbed. Data obtained from this device will be valuable, it is claimed, in aiding road makers in determining the thickness of roads to be constructed on varying kinds of subsurface.



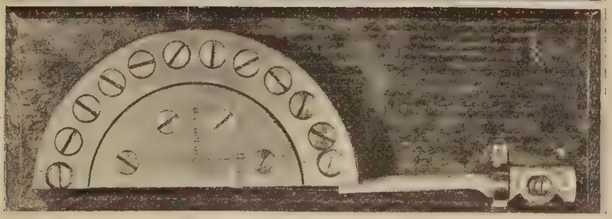


FIG. 1—THE VARIOUS PARTS OF THE SOIL PRESSURE DISC
FIG. 2—LOOKING DOWN AT HALF OF THE SOIL PRESSURE DISC

The Semi-Annual Index to CONCRETE, Vol. 19, July to December, 1921, will be sent to subscribers who ask for it.

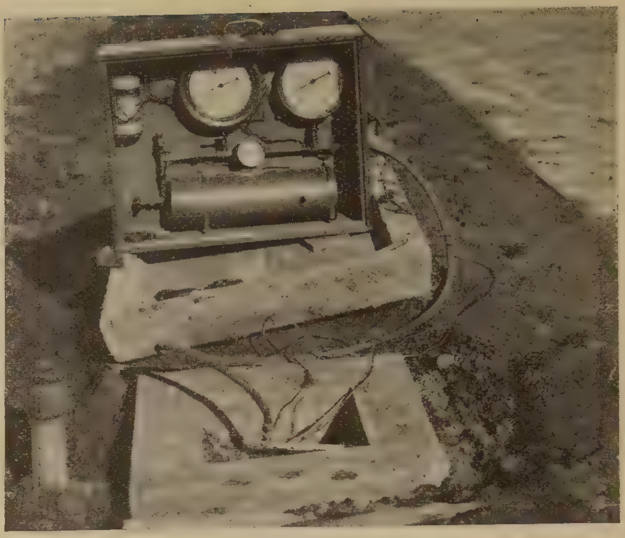


FIG. 3—THE INSTRUMENT CASE USED IN CONNECTION WITH THIS TESTING DEVICE

A Standard Contract

Standardization of construction contracts seems destined to be achieved through a conference held in Washington, D. C., recently.

This conference was composed of delegates appointed by eight national societies, representing the engineers, architects and contractors of the United States, and the definite plan adopted was one which would ultimately produce a standard form of contract "agreement" which would be acceptable in all sections of the country and in all phases of the industry.

A survey of the situation made several months ago by Brigadier-General R. C. Marshall, Jr., chief of the Construction Division, U. S. Army, during the World War, disclosed the fact that today there are in common use throughout the construction industry more than 200 different forms of contract, and that no one state or section had yet been able to establish any one form as standard or customary.

After many months of painstaking comparison and research, W. P. Christie, in charge of this work as research engineer for the Associated General Contractors, reported that the differences were chiefly superficial differences of words and phrasing, rather than differences of meaning or stipulation, and that at least two-thirds of all the provisions contained in each of the 200 documents were common to all, and therefore could be included in one standard contract form, if rewritten in simple universal style.

This plan, together with a "tentative outline," was submitted for consideration to the organizations. All made favorable responses and appointed representatives to come to Washington to constitute a conference on the subject and proceed with the drafting of a tentative form of contract, which could later be officially submitted by the conference to its constituting bodies for criticism, amendments, and ultimate ratification.

Thus the general principles of the universal contract were fixed, and a committee consisting of General Marshall for the constructors, W. S. Parker for the architects, and W. D. Faucette for the railway engineers, was appointed to write out the document in tentative form for correction and approval by the conference at its next meeting.

Selecting Fine Aggregates

By P. J. Freeman
Engineer of Tests, Pittsburgh Testing Laboratory
Pittsburgh, Pa.

In the discussion of causes for the deterioration of a concrete bridge, a recent article in a leading technical magazine called particular attention to the fact that limestone screenings had been used for the fine aggregate and several of the engineers who had examined the structure assumed this to be the cause of the failure. No statement was made, however, as to the grading of the screenings, and whether or not the dust of fracture had been removed before they were used in the concrete.

It was stated by an engineer in charge of the work that it was necessary to use screenings because the natural sand available contained a large amount of organic matter. Available literature on the subject failed to give any information that would lead him to believe that screenings were not entirely suitable for use in concrete. Tensile tests made on the limestone screenings showed a strength much higher than Ottawa sand briquettes. Therefore, he allowed the use of the screenings as the fine aggregate for the concrete.

The writer is required to pass on the suitability of materials to be used for fine aggregate, from samples furnished from all over the United States, and it has been found that there are some fundamental tests which must be made to furnish adequate information as to the quality of a fine aggregate for use in concrete. Engineers are beginning to realize that it is just as necessary to know the quality of the fine aggregate as it is to know the quality of the cement, and the methods which are employed by the writer may be of interest to some engineers who are called upon to select suitable fine aggregates for concrete.

Recent investigation has indicated that the fine aggregate is of more importance in the production of good concrete than the coarse aggregate. It is therefore very important that care be used in the selection of the best fine aggregate which is economically available for any given job.

For determining the suitability of natural sands for use in concrete, it is customary to make the following tests:

(1) Sieve analysis.
(2) Colorimetric tests for organic impurities.
(3) Percentage of loam and silt.
(4) Mortar strength.

To determine the suitability of screenings for use in concrete, the per cent of loam and silt test is omitted, and if it is known that the quarry has been properly worked, the test for organic impurities need not be made. As a general rule, all four of these tests should be made for natural sands, but in some instances the mortar strength test may be sufficient.

Sieve Analysis—The sieve analysis which is made on a carefully dried sample, shows the grading of the fine aggregate and furnishes information as to its probable mortar strength, as well as its general suitability, especially for the construction of concrete highways.

Organic Impurities—The test for injurious organic impurities is usually made by placing a small sample of sand in a standard solution, and noting the change in the solution, which will darken if the sand contains organic matter. This test is not infallible, however, as other substances, such as lignite and small bits of wood will produce a dark color, although they may be in such small quantities that they are entirely harmless when used in concrete.

Loam and Silt—Various methods are in use for determining the percentage of loam or silt which a sand contains, and the method used should be known by the engineer in making his conclusions. The percentage of loam as determined by the elutriation method is less than that which is obtained by the volumetric method. This loam test is especially important for sand which is to be used in reinforced concrete.

Mortar Strength Tests—The mortar strength test is the best method for determining the quality of a fine aggregate, as it has been found that the mortar strength very closely indicates the quality of the concrete which can be obtained with any reasonably good coarse aggregate. In other words, the mortar strength is really the criterion by which to judge a fine aggregate. From recent tests of cores drilled from finished concrete, it seems probable that the compressive strength of the mortar more accurately indicates the quality of the concrete which can be made on the job, than do preliminary tests of the concrete made of the fine aggregate, cement, and coarse aggregate which will be used in the work.

So far as our present knowledge of concrete goes, it would seem that the results of the seven-day compression tests are all that are necessary to judge as to the strength of a fine aggregate, as the 28-day tests always show about the same relative strength to Ottawa standard sand that the 7-day tests show. It is, of course, desirable to have the 28-day tests as a matter of record.

Fine sands generally show the same relative strength to standard sand, whether tested in compression or tension, but coarse sands usually show a lower comparative strength in tension than in compression. Since concrete is always used in compression, it is obvious that sand which is to be used in concrete should also be tested in compression. The results of the compression tests of natural sand mortar are generally more uniform than those obtained from tension tests. The sample to be tested should be selected with great care, so that it truly represents the material to be used, for otherwise the results of the test will be of no value. Since the compression tests are made on 2 in. by 4 in. cylinders, about 20 lbs. of material will be sufficient for all of the tests.

SUMMARY

With the results of these four tests, the engineer can definitely pass an opinion as to the quality of a natural sand.

(A) If the grading is uniform and it contains no organic matter, or an excess of loam, the compressive strength ratio to standard sand will be greater than 100%. Such a sand is satisfactory for use in any concrete.

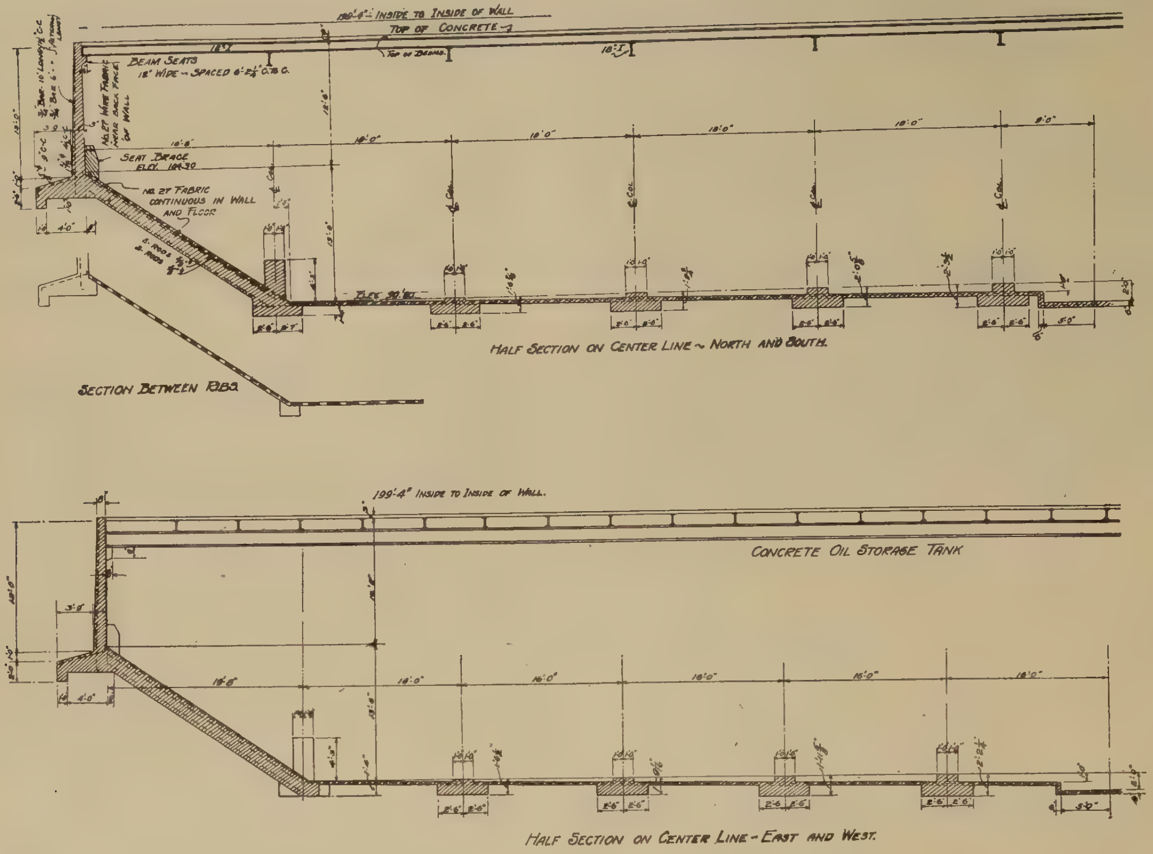
(B) If a natural sand is well graded, with a low percentage of loam, but shows by the colorimetric test a considerable amount of organic matter, the compressive strength may be below that of standard sand, in which case the sand should be rejected. It is sometimes found, however, that the dark color of the solution is produced by small particles of wood or lignite, which are not injurious, and in this case, if the strength ratio is greater than 100%, the sand will be entirely satisfactory for concrete.

(C) If the sand shows an unsatisfactory grading, and is free from organic matter, and an excess of loam, the compressive strength will probably be less than that of standard sand mortar. Such a sand may sometimes be used in unimportant work, with the addition of enough cement to make up for the deficiency in strength.

(D) A sample of sand showing good grading, no organic impurities, and a high compressive strength, but with a large percentage of loam, should not be used without washing.

(E) In determining the suitability of screenings for use in concrete, the engineer must not be misled by the fact that he will usually obtain a very high mortar strength, even though the screenings contain a large amount of dust. No screenings should be used which will not comply with the customary specifications for grading of natural sands. The excess of fine dust must be removed in order to produce satisfactory concrete, regardless of the mortar strength which may be obtained.

It will be seen, therefore, that although the mortar strength test is the most important one, it is not safe to use this test alone, especially for fine aggregates, which are intended for use in first class concrete construction. In order that the engineer may pass an intelligent opinion, he should have not only the mortar strength test of a natural sand, but also the amount of loam and organic matter, and to correctly judge the quality of screenings, he should have the sieve analysis and the mortar strength tests.


199'-4" INSIDE TO INSIDE OF WALL
TOP OF CONCRETE
BEAM SEATS
SEAT BRACE
NO. 27 FABRIC CONTINUOUS IN WALL AND FLOOR
HALF SECTION ON CENTER LINE ~ NORTH AND SOUTH.
SECTION BETWEEN RIBS
199'-4" INSIDE TO INSIDE OF WALL.
CONCRETE OIL STORAGE TANK
HALF SECTION ON CENTER LINE - EAST AND WEST.

Sectional Details of Oil Storage Tank, Showing Ribs and Foundation Piers

Oil Tank Repaired With Super-Cement

The accompanying illustration shows sectional details of a tank constructed at West Tulsa, Okla., which leaked so badly after allowing the usual curing period that it was declared to be unsafe for oil storage. It had remained out of service for a period of six years. When the tank was originally tested with water, after allowing the curing period, the leakage indicated that it was unsafe for oil storage.

The tank was approximately 200 ft. square, and 27 ft. high, having a capacity of 8,000,000 gals. It was located in the Arkansas River valley, and the bottom of the tank was 10 ft. above the river level, in a sandy loam soil. It was originally built in 1915 for the Cosden Oil Co., and was constructed of reinforced portland cement concrete, proportions 1:2:4, with selected aggregates, walls 15 in. thick at the base and 8 in. at the top. The floor was 6 in. thick and the roof slab 3 in. The interior walls and floor were given a special waterproofing treatment.

In February, 1921, Munn Brothers, who had become owners of the tank, awarded the contract for plastering the inside of the walls ½ in. thick and the floor 1 in. thick, with Super cement mortar. The work of plastering was completed in May. Early in September, 1921, the tank was filled with fuel oil and the gauging of the contents twice daily since then has established the fact that the tank is oil tight.

The tank was sold to the present owners, The North American Car Co., which reported December 1, 1921, that the daily gauging of the tank gave no indication of seepage.

The plastering on the interior of the tank, using Super cement, was done by the Monahan Plastering Co., Tulsa, Okla.

It is reported that no hair cracks appeared on the surface.

Super cement is defined by the manufacturers as an improved portland cement, which is packed and shipped in bags of the same size and weight as portland cement and looks the same, and which is mixed in the same manner as portland cement to make mortar or concrete. They say a new and improved process of making cement is used in its manufacture, and during this process specially treated gypsum is added to the cement clinker before it is ground, the virtue of this addition to the cement clinker being in making the particles of Super cement combine freely with the mixing water. For this information Concrete is indebted to Super Cement Co. (America), Ltd., Toronto, Canada.

The Twenty-fifth Annual Meeting of the American Society for Testing Materials will be held June 26-July 1, 1922, at Atlantic City, N. J. Headquarters will be at Chalfonte-Haddon Hall Hotel.

It is announced that the Second Annual Own Your Home Exposition will be held in the Coliseum, Chicago, March 25, to April 1. More than 100,000 visitors attended the first show. It is expected that the coming show will be even better attended and the interest of the exhibitors is already indicated.

Cost Analysis of Day Labor Construction of Wisconsin Concrete Roads

Detailed Record of Work in Five Counties, With Description of Methods Producing Each Cost Result

By H. J. Kuelling
Construction Engineer, Wisconsin Highway Commission
Madison

The best way for a state highway department to make proper estimates is to have some day labor operations of its own from which to get trustworthy data.

For several years the Wisconsin Highway Commission has been doing a certain amount of day labor construction on all types of work. Previous to the enactment of the Federal Aid laws this day labor construction was entirely in the hands of the various county authorities. With the coming of the Federal laws a considerable portion of it was handled directly by the Commission itself. The work during the last year has been a combination of these two methods.

While the primary reason for doing this construction has been to obtain trustworthy data, some of the counties are carrying on their day labor work on an entirely business basis. In other words, they believe they can save money by operating in this way. No matter what the reason, the result has been that the Commission and the counties have obtained some very valuable information, and the contractors know that the bids submitted must be within reason, and that the engineers generally know what they are talking about when they pass on bids.

This paper will be confined entirely to operations on concrete roads, five of which jobs were carried on during the last year.

In order to have our data in proper shape and comparable a very detailed cost accounting system was adopted by the Commission some time ago. This system is a decimal system, thus making it very flexible and one that can be contracted or expanded as we see fit with each individual job.

A code sheet was made out to cover all important items of construction, classified according to the main headings: Administration and Preliminaries; Earth Work; Culverts; Bridges; Surfacing; Supplementary Construction; Pit and Quarry, and Camp Operation. These were further subdivided into all the minute operations that might interest the Commission in a cost analysis. This code sheet was made up so that one can use the main headings or the detailed classification without changing the method of bookkeeping. It should be borne in mind that the information that is received from any data is no more accurate than the method that is used in getting it. Therefore, if a contractor or the operator of day labor construction feels that he is interested in only the main headings, the cost analysis should be made on that basis. If at the end of the year he further subdivides the main headings into smaller operations, solely on what he recalls was his average organization, or by pro-rating the cost, he is generally biased by the intention for which he is getting out the data. The only proper way to do is to determine what information is wanted, and get the cost as the work progresses, using every check possible to see that it is correct.

In the operation of the jobs under discussion all costs were divided into two classes under the various subdivisions. They were labor and material. Each laborer's time was entered on a separate time slip, which showed exactly how many hours each day was spent on a particular piece of work. Twice a month these slips were entered on a payroll summary, from which the payroll was made up. The totals from the payroll summary were then entered in a ledger showing the entire labor distribution. All invoices from purchases of material were classified as soon as they reached the office, while the purchase was stil fresh in the mind of the men in charge. On all jobs an effort was made to have the bills sent in every month. Every two weeks the invoices were compiled in a summary and the proper distribution entered in the ledger with the payrolls.

In making a charge for machinery, in other words, the amount of depreciation, a regularly adapted scheme was adopted. This scheme or table was one that was drawn up two years ago in Wisconsin at a meeting of contractors, machinery men, material men, and the engineers of the Wisconsin Highway Commission. A committee representing all interests was appointed to draw up a cost accounting scheme, and in this scheme they entered a depreciation sheet. This sheet was drawn up on the basis of per cent of original cost per mile of road. This sheet has been described before in the technical press, and will not be discussed here. Suffice it to say that the depreciation used in cost data submitted herewith is based entirely on this depreciation sheet, which was adopted by this composite committee.

In case any contractor desires to compare the enclosed data with his own data, and in case he has not used this method of depreciation, all that is required is for him to adjust the depreciation items in accordance with his own method of depreciation, and he will have a correct comparison.

On all jobs generous allowance is made for county overhead and administtation, although this is not actually paid from the funds for the job. This cost was based on the per cent per thousand dollars expended and the rate was obtained from the actual cost of the administration fund in the various counties. In order to make the tabulation of costs as compact as possible, the unit costs were expressed in cost per square yard of paving, cost per cubic yard of grading, and cost per cubic yard for structures.

As an illustration of the cost accounting method, we note from the table of costs that No. 534 is the general number for coarse aggregate. (See double page tabula-

Detailed Costs of Concrete Road Construction in Five Wisconsin Counties, 1921—Methods and Conditions Producing These Costs Described in Text—(Continued on Opposite Page)

		WINNEBAGO CO. NEENAH-OSKOSH #116			RACINE CO. N. CAPE RD.			WASHINGTON CO MIL.-W. BEND RD.			ROCK CO. JANES-EDGER. RD.				WINNEBAGO CO. OSHKOSH-NEENAH #20		
INDEX	OPERATION	TOTAL COST	COST PER SQ. YD.	COST PER BBL.	TOTAL COST	COST PER SQ. YD.	COST PER BBL.	TOTAL COST	COST PER SQ. YD.	COST PER BBL.	TOTAL COST	COST PER SQ. YD.	COST PER BBL.		TOTAL COST	COST PER SQ. YD.	COST PER BBL.
	CEMENT	15,950 BBLS. (1:2:3½ MIX)			13,648½ BBLS. (1:2:4 MIX)			18,701 BBLS. 1:2:4 MIX			24,870 BBLS. 1:2:4 MIX				10,562 BBLS. 1:2:4 MIX		
1401	CEMENT TESTS	174.92	.004	.011	271.02	.006	.02	352.18	.006	.019	533.34	.007	0.02		131.48	.004	.012
53201	COST F.O.B. MILL (EXCLUSIVE OF SACKS)	27,537.38	.590	1.732	22,904.63	.486	1.68	31473.80	.541	1.683	43,148.16	.586	1.736		19721.60	.610	1.867
53202	SACK LOSS	77.31	.002	.005	6.50	—	—	66.00	.001	.001	* 196.75	.003	.008		41.80	.001	.004
53203	FREIGHT TO DESTINATION	9,305.06	.199	.585	7,240.13	.154	.53	6516.03	.112	.348	12086.20	.164	.486		4901.23	.152	.464
53204	DEMURRAGE	—	—	—	16.12	—	—	328.00	.006	.018	98.00	.004	.004		39.00	.001	.004
53205	UNLOADING-LABOR	1,107.93	.024	.091	—	—	—	39.30	.001	—	589.85	.008	.024		696.22	.021	.066
	" " GLOVES	—	—	—	—	—	—				28.00	—	.001		13.30	—	.001
53209	STORING	609.28	.013	.166	—	—	—				337.13	.005	.013		54.35	.002	.005
532.10	REHANDLING FROM STORAGE	295.95	.006	.081	25.13	—	—				339.73	.005	.013		—	—	
532.11	HAULING BY TEAM										—	—			—	—	
532.12	" " " TRUCK—LABOR	1,726.11	.037	.108	4251.04	.090	.31	4684.71	.081	.251	2673.85	.036	.108		—	—	
532.13	" " " " —FUEL, OIL, ETC.										1439.02	.020	.058		—	—	
532.14	" " " " RENTAL OF EQUIP.										549.36	.007	.022		—	—	
532.15	" " " " DEPRECIATION OF EQUIP.	—	—	—	—	—	—				2577.78	.035	.104		—	—	
532.18	" " " INDUSTRIAL EQUIPMENT	—	—	—	—	—	—				7.00	—	—		1059.21	.033	.100
532.24	SORTING, BALING & RETURNING SACKS	395.46	.008	.025	83.25	.002	.01	309.51	.005	.016	759.70	.010	.031		314.03	.010	.030
532.25	CEMENT LOSS	—	—	—							CREDIT 528.36	.007	.021		—	—	
	TOTALS ON CEMENT	41,229.40	.883	2.59	34797.82	.738	2.55	43769.53	.753	2.34	64835.49	.880	2.60		26,912.22	.834	2.55
	FINE AGGREGATE	4,876 CU. YDS. COST PER CU. YD.			5510 CU. YDS. COST PER CU. YD.			7,360 CU. YDS. COST. CU. YD.							3100 CU. YDS. COST. CU. YD.		
533.01	COST F.O.B. PIT OR QUARRY	4352.60	.093	.893	2326.61	.049	.422	5659.84	.097	.0769					2,011.62	.062	.647
533.02	FREIGHT TO DESTINATION	5018.83	.108	1.029	—	—	—	—	—	—					3,010.52	.093	.969
533.03	DEMURRAGE	—	—	—	—	—	—	—	—	—					20.00	.001	.006
533.04	UNLOADING—LABOR	534.40	.012	.110	—	—	—	—	—	—					707.56	.022	.227
533.05	UNLOADING—FUEL-OIL, ETC.	95.82	.002	.020				—	—	—					55.57	.002	.018
533.07	" DEPRECIATION OF EQUIP.	543.18	.012	.111				—	—	—					174.00	.005	.056
533.10	STORING OR STOCK PILING	6.40	—	.001				—	—	—					12.60	—	.004
533.11	REHANDLING	20.49	—	.004	3.94	—	—	—	—	—					121.65	.004	.039
533.20	HAULING BY TRUCK	10.39	—	.002	12359.38	.262	2.242	6011.35	.103	.0816							
	" BY CAR	1886.72	.040	.387				—	—	—					2,253.33	.070	.725
533.28	RENTAL OF DUMP CARS	372.26	.008	.076	—	—	—	—	—	—							
	SPOTTING MATERIAL	—	—	—	216.22	.005	.039	—	—	—							
	TOTALS ON FINE AGGREGATE	12841.09	.275	2.63	14,906.15	.316	2.70	11,671.19	.200	1.59					8366.85	.259	2.69
	COARSE AGGREGATE	8,456 CU. YDS. COST PER CU. YD.			9586 CU. YDS. COST PER CU. YD.			13,962 CU. YDS. COST PER CU. YD.			FINE AGGREGATE & COARSE 19,658 CU. YDS. COST PER CU. YD.				6358 CU. YDS. (TRUCKS & TEAMS) COST PER CU. YD.		
534.01	COST F.O.B. PIT OR QUARRY	9259.41	.199	1.095	11,521.74	.245		10,736.39	.185	.769					10,612.88	.328	1.669
534.02	FREIGHT TO DESTINATION	10,132.14	.217	1.198	—	—	—	—	—	—					1367.64	.042	.215
534.03	DEMURRAGE	—	—	—	—	—	—	—	—	—					20.00	.001	.003
534.04	UNLOADING—LABOR	964.98	.021	.114	—	—	—								368.19	.011	.058
534.05	" " FUEL, OIL, ETC.	170.27	.004	.020	—	—	—								27.00	.001	.004
534.07	" " DEPRECIATION OF EQUIP.	966.22	.020	.114	—	—	—								84.57	.003	.013
534.10	STORING OR STOCK PILING	3.60	—	—	—	—	—								7.20	—	.001
534.11	REHANDLING FROM STOCK PILE	7.69	—	.001	155.81	.003	.016								15.95	—	.003
534.20	HAULING BY TRUCK	9.99	—	.001	22,252.07	.472	2.32	11,886.24	.204	.851					3185.36	.099	.501
	" " CAR	3712.03	.080	.439											361.62	.011	.057
534.27	RENTAL OF DUMP CARS	661.49	.014	.078											97.28	.003	.015
	SPOTTING MATERIAL	—	—	—	376.00	.008	.039										
	TOTALS ON COARSE AGGREGATE	25888.42	.555	3.06	34305.62	.728	3.58	22622.63	.389	1.62	21021.81	.285	1.07		16147.69	.499	2.539
	JOINT AND REINFORCING MATERIAL																
535.01	JOINT MATERIAL DEL. ON JOB	485.69	.010		646.53	.014		960.98			—	—			298.20	.009	
535.02	REINFORCING " " " "	88.33	.002		39.00	.001		—			—	—			—	—	
	TOTALS	574.02	.012		685.53	.015		960.98	.017						298.20	.009	
	MIXING & PLACING	46,675 SQ. YDS.			47,105 SQ. YDS.			58,132 SQ. YDS.			73,656 SQ. YDS.				32,336 SQ. YDS.		
531.01	PREPARATION & MAINTENANCE, SUBGRADE	748.75	.016		1942.99	.041		3432.82	.059		2651.23	.036			541.13	.017	
536.01	SETTING FORMS—LABOR	486.57	.010		844.70	.018		1360.31	.023		2352.60	.032			441.11	.014	
	" " MATERIAL	218.78	.005		192.17	.004		349.60	.006		—	—			247.09	.008	
536.02	SHOVELING & WHEELING	3389.22	.073		4498.89	.095		735.03	.126		—	—			2089.02	.065	
536.05	HANDLING CEMENT	452.90	.010		704.81	.015		976.92	.017		1706.62	.023			318.60	.010	
536.06	PLACING REINFORCING STEEL	—	—		2.81	—		—			—				—	—	
536.07	OPERATING MIXER—LABOR	717.80	.015		448.43	.010		721.46	.012		1210.85	.017			533.50	.016	
536.08	" " " " FUEL, OIL, ETC.	335.57	.007		311.89	.007		892.09	.015		704.32	.010			257.73	.008	
536.09	PUDDLING	480.29	.010		433.80	.009		1154.18	.020		2,[illegible]5.39	.030			269.90	.008	
536.10	FINISHING—LABOR	585.92	.013		904.91	.019		1689.28	.029		1402.00	.019			513.50	.016	
536.11	" FUEL, OIL, ETC.	—	—		—	—		—			86.24	.001			—	—	
536.13	DEPRECIATION OF PAVING EQUIP.	2224.21	.048		2386.39	.051		3404.40	.059		2528.76	.034			1543.11	.048	
536.14	REPAIRS TO RENTED EQUIPMENT	—	—		2.93	—		—			—	—			—	—	
536.16	SUNDRY SUPPLIES	207.04	.004		3.63	SEE 539.12		141.83	.002		271.40	.004			—	—	
536.17	CURING	153.40	.003		143.30	.003		488.25	.008		402.18	.005			145.45	.004	
536.18	COVERING	943.20	.020		932.21	.020		647.31	.011		1233.40	.017			589.56	.018	
	TOTAL	10943.65	.234		13753.86	.292		22610.38	.389		16804.99	.228			7489.72	.232	
	WATER SUPPLY																
537.01	DIGGING RESERVOIR				59.04	.001									—	—	
537.02	SETTING PUMP	27.87	.001		69.03	.001		38.05	.001		49.00	.001			14.00	—	
537.03	HAULING & CONNECTING PIPE	171.77	.004		395.52	.008		261.69	.004		835.29	.012			114.60	.004	
537.04	PUMPING—LABOR	241.60	.005		241.51	.005		302.35	.005		684.70	.010			137.60	.004	
537.05	" FUEL, OIL, ETC.	124.16	.003		83.31	.002		347.42	.006		540.33	.007			105.29	.003	
537.06	DISCONNECTING PIPE	79.55	.002		111.46	.002		177.06	.003		395.84	.005			31.15	.001	
537.08	DEPRECIATION OF EQUIP.	828.17	.017		1271.16	.027		1026.50	.018		1935.15	.026			527.78	.016	
537.11	WATER RENT	162.38	.003		—	—					—				—	—	
	TOTAL	1635.50	.035		2231.03	.047		2153.01	.037		4490.31	.061			930.42	.028	
	HAULING MIXED CONCRETE										16,012 CU. YDS.		COST PER CU. YD. CONCRETE	COST PER MI. OF TRACK			
538.01	PREPARATION OF GRADE FOR TRACK										1474.54	.020	.092	140.43			
538.02	ASSEMBLING IND. EQUIP. ON JOB.										468.40	.006	.029	44.61			
538.03	LAYING TIES AND STEEL RAILS										1772.36	.024	.111	168.80			
538.04	MAINTENANCE OF TRACK										790.15	.011	.050	75.25			
538.05	OPERATING IND. EQUIP.—LABOR										2997.83	.041	.187				
538.06	" " " FUEL & OIL										2016.75	.027	.126				
538.07	RENTAL OF INDUSTRIAL EQUIP.										2000.00	.027	.125				
538.08	DEPRECIATION " "										6678.13	.091	.417				
538.09	REPAIRS TO RENTED "										424.16	.006	.027				
538.11	TAKING UP TRACK.										823.49	.011	.051	78.42			
538.12	RETURNING EQUIP. TO STORAGE										—	—	—				
538.13	HAULING BY TRUCK										18.00	—	—				
538.19	UNLOADING AT JOB—LABOR										990.90	.013	.062				
538.20	" " " FUEL, OIL, ETC.										609.96	.008	.038				
538.22	DEPRECIATION										1687.91	.023	.105				
	TOTAL										22752.58	.308	1.42	507.51			
	SUNDRY COSTS.																
539.01	ASSEMBLING AND ERECTING EQUIP. ON JOB	64.45	.001		204.70	.004		246.15	.004		626.94	.009			263.94	.008	
539.02	MOVING DURING COURSE OF CONST.	—	—		—	—		149.14	.003		1176.60	.016					
539.03	RETURNING EQUIPMENT TO STORAGE	175.88	.004		292.86	.006		187.65	.003		496.58	.007			440.23	.014	
539.04	TRANSPORTING MEN TO & FROM WORK	749.30	.016					582.12	.010		—	—			1374.05	.042	
539.05	SUPERVISION & RECORDING	1459.41	.032		910.00	.019		2275.55	.039		2320.51	.032			1427.71	.044	
539.07	WATCHMEN	—	—		8.63	—		2.50	—		—	—			—	—	
539.08	WATERBOYS	82.48			95.47	.002		203.04	.003		—	—			55.30	.002	
539.09	CAMP LOSS	—	—		1179.40	.025		* 2000.00	.034		277.11	.004			—	—	
539.10	BARRICADE & LIGHTS	51.69	.001		47.23	.001		49.16	.001		108.85	.001			18.35	.001	
539.12	SMALL TOOLS	206.72	.004		393.14	.008		435.60	.008		361.98	.004			82.50	.003	
539.13	LOST TIME OF EQUIPMENT	—	—		—	—		—	—		678.82	.009			—	—	
539.14	RENT OF GROUND	—	—		—	—		—	—		42.68	.001			—	—	
539.15	BUILDING CROSS OVERS	38.75	.001		17.84	—		52.05	.001		76.48	.001			7.65	—	
539.16	MAINTAINING ROAD FOR CEMENT (HAUL	—	—		—	—		—	—		605.21	.008			—	—	
	BLACKSMITH	—	—		—	—		—	—		91.00	.001			—	—	
	LOST TIME OF LABOR	—	—		24.43	.001		—	—		—				—	—	
	MOVING CAMP	—	—		—	—		—	—		353.63	.005			—	—	
	TOTAL	2826.74	.061		3173.67	.066		6182.16	.106		7216.39	.098			3669.73	.114	
*RECORDS NOT COMPLETE	ADMINISTRATION																
	GENERAL SUPERVISION EST. OF COUNTY (CHARGE	* 400.00	.009		* 2024.25	.043		* 4300.00	.074		* 800.00	.013			* 400.00	.012	
	ACCOUNTING	149.25	.003		70.28	.001		93.35	.002		—				207.00	.006	
	SIDING	1278.20	.027		—			—			—						
	INSURANCE & LIABILITY	165.79	.004		865.37	.018		* 1500.00	.026		2.50 (DOCTOR BILL)				200.62	.006	
	MATERIAL INVESTIGATION										17.00	.002			2.62		
	TOTALS ON ADMINISTRATION	1993.24	.043		2959.90	.062		5893.35	.102		819.50	.015			810.24	.024	
	TOTALS ON PAVING	97934.06	2.10		106813.59	2.26		115863.23	1.99		137,941.07	1.87			64,685.01	2.00	

(Continued from previous page)

		WINNEBAGO CO.				RACINE CO.				WASHINGTON CO.				ROCK CO.				WINNEBAGO CO.			
		NEENAH-OSKOSH #16				N. CAPE RD.				MIL-W. BEND RD.				JANES.-EDGER RD.				OSHKOSH-NEENAH #20			
			TOTAL COST	COST PER C.Y.	COST PER MILE		TOTAL COST	COST PER C.Y.	COST PER MILE		TOTAL COST	COST PER C.Y.	COST PER MILE		TOTAL COST	COST PER C.Y.	COST PER MILE		TOTAL COST	COST PER C.Y.	COST PER MILE
	EARTH WORK GRADING AHEAD OF MIXER																				
21	STAKING	11,622 CU. YDS.	154.50	.013		12,011 CU. YDS.	66.52	.006	14.88	20627 CU. YDS.	27.29	.002		21,667 CU. YDS.	1007.02	.046	144.00	6882 CU. YD. (UNCLASS.)	134.15	.019	43.98
22	CLEARING AND GRUBBING						207.92	.018	46.51		70.70	.003			—						
	DITCHING BEYOND R/W										201.01	.010			830.12	.038	118.59				
23.01	LABOR AND TEAMS		5635.84	.485			7153.78	.596	1600.40		13969.02	.677		CONTRACT	16073.34	.74	2290.00		5211.93	.757	1708.82
23.02	FUEL & OIL		128.31	.011			492.69	.041	110.20		936.42	.045			—						
23.04	DEPRECIATION OF EQUIP		520.76	.045			893.85	.074	198.63		1515.33	.073			—				434.43	.063	142.44
23.07	BREAKING UP ROAD		441.67	.038			—	—			120.70	.006			41.48		6.00		700.63	.102	229.71
29.01	ASSEMBLING AND ERECTING		243.58	.021			99.89	.007	22.34		17.00	.001							256.75	.037	84.18
29.05	SUPERVISION & RECORDING		179.81	.015			782.00	.065	174.94		7.88 (SEE 23.01)								233.73	.035	76.63
29.09	CAMP LOSS		1184.80	.102			547.59	.046	122.50		459.05	.022						(INCLUDES INSURANCE	1053.99	.152	343.32
29.08	WATER BOYS		—	—			15.80	.001	3.53		1.05	—									
29.02	MOVING DURING CONSTRUCTION		—	—			11.30	.001	2.23		286.58	.014									
29.11	DETOURS		—	—			—	—			4.55	—									
29.12	SMALL TOOLS		30.62	.003			61.08	.005	13.57		34.10	.002							21.44	.003	7.03
29.15	LOST TIME		—	—			231.42	.019	51.77		—	—									
29.04	TRANSPORTING MEN TO & FROM (JOB		530.04	.046			—	—		1920 WORK	132.65	.006							319.27	.046	104.68
29.10	BARRICADE AND LIGHTS		46.08	.004			—	—			6.75	—							7.57	.001	2.48
29.14	RENT OF GROUND		15.65	.001			—	—			81.23	.004		256 CU. YDS.					45.60	.007	14.96
24.01	LOOSE ROCK		—	—			—	—			14.00	.001			384.00	1.50	55.00				
	TOTALS ON ROUGH GRADING		9111.66	.784	2066		10563.84	.879	2363		17,885.31	.867	3252		18335.96				8419.49	1.22	2758.23
											3695.04	.87 MI.									
	SHOULDERS									TO COMPLET SHOULDERS ALLOW $950	950.00	.046		ALLOW 250.00 PER MI. TO COMPLETE SHOULDERS = $1750.00	1750.00		250.00				
28.01	LABOR & TEAMS		4364.85	.376	992.00		6263.30	.521	1401.19		3620.03	.175			1438.70		206.00	(LIAB. INS.	3042.87	.442	997.66
28.02	FUEL OIL ETC.						19.25	.001	4.30						416.88		59.55		90.58	.013	29.70
28.04	DEPRECIATION OF EQUIP.		138.81	.012	31.55		47.46	.004	10.55		37.32	.002			294.77		42.00		129.55	.019	42.48
29.02	MOVING DURING CONST. (JOB		223.01	.018	50.68										8.10		1.00		143.90	.021	47.18
29.04	TRANSPORTING MEN TO & FROM		183.40	.057	41.68						30.00	.001						(RETURN TO STORAGE	99.91	.014	32.76
29.05	SUPERVISION & RECORDING		210.44	.019	47.83		365.04	.030	81.66										266.00	.039	87.21
29.09	CAMP LOSS		666.45	.016	151.47		256.00	.021	57.25										330.67	.048	108.42
29.12	SMALL TOOLS		10.26	.001	2.33		27.56	.002	6.12		12.00	.001							220.75	.032	72.37
29.14	RENT OF GROUND		5.25		1.19														14.40	.002	4.72
	TOTALS ON SHOULDERS		5802.47	.499	$1319		6978.61	.579	$1561		4649.35	.224	1043		3908.45		558		4338.63	.630	1422.50
	TOTALS ON EARTH WORK		14914.13	1.28	$3385		17542.45	1.46	$3924		26229.70	1.09	$4751		22244.41	1.03			12758.12	1.85	[illegible]
	CULVERTS				COST PER C.Y.				COST PER C.Y.												
31.01	FINE AGGREGATE F.O.B. PIT	34.6 CU. YDS.	38.44		1.111	106.7 CU. YDS.	48.00		.45	241.6 CU. YD.	121.48	.50		2790* 214.3 CU. YDS.				87.1 CU. YDS.	64.64	.743	
31.02	COARSE " " " "		72.28		2.089		90.00		.84		248.30	1.03							146.80	1.685	
31.03	CEMENT F.O.B. SIDING		121.16		3.501		352.43		3.31	CULVERT QUANTITIES INCLUDE 24' SPAN BRIDGE	884.64	3.66			623.61		2.90		319.06	3.663	
31.04	LUMBER		14.43		.414		76.01		.71		481.92	1.99			4.50		.02		125.69	1.443	
31.05	REINFORCING STEEL		79.15		2.288		79.40		.75		271.28	1.12			125.55		.58		84.39	.969	
33.01	EXCAVATING-LABOR		66.15		1.912		159.44		1.49		684.78	2.83							187.61	2.154	
33.02	REMOVING OLD STRUCTURES						48.46		.45		99.41	.42			9.00		.04				
33.03	FORMING		75.30		2.176		144.11		1.35		461.77	1.91			42.69		.20		72.50	.832	
33.04	PLACING REIN. STEEL						9.12		.09		25.12	.10			3214.50		15.00				
33.05	MIXING & PLACING CONCRETE		45.15		1.305		152.86		1.43		421.28	1.74		CULVERTS CONTRACTED FOR $15.00 PER CU. YD. NOT INCLUDING CEMENT & STEEL					153.48	1.762	
33.06	FINISHING		26.60		.769		67.61		.63		218.45	.90							40.25	.462	
33.07	REMOVING FORMS		21.10		.610		61.58		.58		95.80	.40							25.55	.293	
33.08	BACK FILLING						38.87		.36		54.30	.22									
34.01	FUEL, OIL, ETC.						9.71		.09		87.57	.36									
34.02	RENTAL OF EQUIP.										2.15	.01									
34.03	DEPRECIATION OF EQUIP.		12.06		.349		115.02		1.08		226.11	.91						(INSURANCE	30.35	.348	
39.01	ASSEMBLING & ERECTING		2.20		.063		9.84		.09		—								8.53	.098	
39.02	MOVING DURING CONST.						61.20		.57		23.65	.09							21.85	.251	
39.04	TRANSPORTING MEN		.70		.020						59.00	.24									
39.05	SUPERVISION & RECORDING		9.75		.282		205.10		1.93		2.45	.01							152.05	1.746	
39.08	WATER BOYS										.95	—									
39.09	CAMP LOSS						103.45		.97		—								16.88	.188	
39.10	BARRICADE & LIGHTS										13.21	.06							3.36	.039	
39.12	SMALL TOOLS						13.52		.13		11.03	.06							4.00	.046	
39.15	LOST TIME						11.71		.11												
32.01	HAULING BY TEAM						7.50		.07		1.05	—							15.75	.181	
32.02	" " TRUCK		74.07		2.141		369.80		3.47												
32.03	" " FUEL & OIL						41.11		.39		468.05	1.94							193.29	2.219	
32.07	REPAIRS						7.57		.07												
31.07	VITRIFIED PIPE		21.39		.619																
	TOTALS ON CULVERTS		679.93		19.65		2283.42		21.40		4963.75	20.54			4019.85		18.79		1,665.53	19.12	--
	CULVERTS BUILT IN 1920		2220.34								7082.43	(1920)									
	RIGHT OF WAY										1375.00				6382.72						
	GUARD RAIL														249.28				148.95		
	EXTRAS-OPENING CULVERTS & (DRAIN TILE		300.35				18.97				16.56										
	* RECORDS NOT COMPLETE		116048.81 4.41 MILES $26,315 PER MIL				126658.43 4.47 MILES $28,335 PER MI.				155,530.67 5.5 MILES $28,278 PER MI.				170837.33 7 MILES $24,405 PER MI.				79257.67 3.05 MILES $25,986 PER MI.		

tion.) Under this there are several subdivisions which are given a decimal number, but all carry the preliminary number of 534. It will be readily noted that this method of subdivision may be carried out as far as anyone desires, each of the items named being capable of further subdivision if desirable.

The five jobs described in this paper are quite variable, but all were standard Wisconsin roads, 18 ft. wide, 7 in. thick at edge, 8 in. in center.

THE FIVE JOBS

One was the Neenah-Oshkosh road, which was divided into two parts, known as Project 116, which was Federal construction, and Project 20, which was not. The first operation was the construction of 4.41 miles from the 1920 operation south to the city limits of Oshkosh. The paver was then moved to the north end of the 1920 operation and a three-mile stretch was constructed into the city of Neenah. This information is especially interesting, in that the jobs were run by the same crew during the same season under different circumstances. On the first operation the material was hauled by trolley to the road, while on the second job it was hauled principally by team and truck. Another added feature was the fact that the county operated a stone quarry and produced coarse aggregate for the second operation.

In Washington county a 5½ mile stretch was built north from the 1920 operation. In Racine county there was built a 4½ mile stretch on the North Cape road, with a very long truck haul. In Rock county there was built a 7-mile stretch with a central mixing plant and an industrial railway haul of mixed concrete.

A brief description of each job and the costs obtained follows:

As noted above, the Winnebago county operation on the Oshkosh-Neenah road was in two sections. The completion of these two sections completed a 50-mile stretch between Oshkosh and Green Bay.

The grading was done with teams and wheel scrapers, use being made of a gasoline roller and scarifier to break up the old macadam road which was there. Grading operations were started April 11, and the road was ready for paving June 22nd. The net operating time for grading on this section was 52 days, or an average of 12 days per mile.

The cost of excavation ahead of the mixer was 78c per cu. yd. in spite of the very hard conditions existing. The cost of shouldering was $1,319.00 per mile. The shouldering on this job was rather difficult, as the material had to be carried across the road, owing to the existence of an electric railway alongside. The shouldering operations took 34 days, or a mile in every 8 days. When the grading was completed on this section the crew moved to the north section, or what is known as Project No. 20.

The net operating time for rough grading was 47 days, or an average of 16 days per mile. The cost of moving earth ahead of the mixer was $1.20 per cu. yd., which included some loose rock excavation. The cost of shouldering was $1,423 per mile.

Paving operations began in this county on the south portion May 30 and ended on July 28, or 47 operating days. The average per day was 498 lin. ft., with a maximum per day of 614 ft., so that it will be noted that this was a very uniform operation. The best week's run was 3,489 ft., and the total square yardage laid 46,657. The cost of paving was $2.10 per sq. yd. The material was shipped in by rail and transferred to the electric railway by clamshell, hauled to the road and dumped on the subgrade from the electric railway. The material was then picked up in wheelbarrows and deposited in the mixer.

It will be noted from the charts that the costs are divided as follows:

	Per sq. yd.
Cement in place	$0.883
Fine aggregate in place	.275
Coarse aggregate in place	.555
Joint material	.012
Mixing and placing	.234
Water supply	.035
Sundry costs	.061
Administration and preliminaries	.043

Or a total, as noted above, of $2.10 per sq. yd.

The north section, near Neenah, was built with the same equipment and crew, under rather different conditions. Fine aggregate was shipped to two different sidings. That shipped to one siding was hauled on the electric line to the road, and the material shipped to the other siding was hauled by truck or team. The greater portion of the coarse aggregate was obtained from a local quarry, which was about in the center of the project and adjoining the road. The crushed stone produced was very hard limestone and of good quality. The material was produced at $1.76 per cu. yd., which netted a saving of 60c per cu. yd. over any possible shipped-in coarse aggregate.

Paving operations began on August 2 and ended September 17, during which time there were 35 days on which concrete was poured. Of these 35 days seven days' time was lost, due to rain. The total square yardage was 32,336. The average run per day was 459 ft., and the maximum 607.

The total cost of the operation on the second job was $2 per sq. yd., divided as follows:

	Per sq. yd.
Cement in place	$0.834
Fine aggregate in place	.259
Coarse aggregate in place	.499
Joint material	.009
Mixing and placing	.232
Water supply	.028
Sundry costs	.114
Administration and preliminaries	.024

The Washington county operation, known as the Milwaukee-West Bend road, was constructed from a local gravel pit. Work was begun one mile north of the pit, working back toward the pit. The mixer was then moved further south, and the paving proceeded north toward the pit, after which the operation was continued further north, hauling over the first piece built.

Aggregates were produced in a county pit, where the material was excavated with a stiff legged derrick, and later with a derrick and drag line when greater production was desired. The material was elevated to the screen by a belt conveyor. It was then washed and screened, the rejections going to the crusher. This material was produced for 74c per cu. yd., in the bins; that is, an average yard of sand and gravel. The material was hauled to the road under contract and dumped in stock piles on the subgrade. Later the material was shoveled from the subgrade and wheeled into a 5-sack Rex paver. After it was deposited it was struck off, tamped and finished by hand, as were the operations on the two previous jobs.

Paving operations began June 11, and the work was completed on November 2. During that time there were 97 days when the crew worked whole or part time. The mixer was idle 22 days, due to moving, rain, and machinery break-down. The average per day was 305 ft., with a maximum of 550 ft. This, by the way, was the poorest operation we had during the season.

The total length of paving was 5.5 miles, with a square yardage of 58,132. The maximum cost of paving was $1.99 per sq. yd., distributed as follows:

	Per sq. yd.
Cement in place	$0.753
Fine aggregate	.200
Coarse aggregate	.389
Joint material	.017
Mixing and placing	.389
Water and supply	.037
Sundry costs	.106
Administration and preliminaries	.102

The grading ahead of the mixer cost 87c per cu. yd., and the culverts $20.54 per cu. yd., including a 24-ft. span bridge.

In Racine county, on what is known as the North Cape road, 4.5 miles was built. This was advertised early in the year, and bids were received as follows:

Paving, per sq. yd.	$2.89
Excavation, per cu. yd.	1.28
Culverts, per cu. yd.	30.00

We believed that these prices were too high, and the job was undertaken by day labor.

A new paving equipment was purchased and the results for the season showed a total saving of $28,944. This does not represent exactly the profit of the contractor, but a very large per cent would have been profit.

The grading on this work was done with old equipment, which was inadequate for the amount of excavation involved. Every effort was made to keep from distributing the old roadbed until the concrete aggregates were deposited in stock piles on the finished grade. This interfered to a considerable extent with grading operations. The cost of grading ahead of the mixer was 88c per cu. yd.; the cost of shouldering was $1,560 per mile. The shouldering cost was excessive, due to the light excavation, which necessitated widening the ditches for shoulder material, most of this work being done during the wetter part of the season. The culverts were built by day labor and cost $21.40 per cu. yd.

The aggregates for the concrete paving were hauled under contract for $2.24 per cu. yd., and deposited in stock piles on the finished subgrade. The average haul was 16.5 miles. It will be noted that this was a very low price on trucking. It will be further noted that the trucking company was willing to do more of it.

The cement was hauled 9.5 miles, at a cost of 29c per bbl.

There was no available water supply in the locality. To eliminate drilling a well, an attempt was made to secure water from a drain ditch, and a 1 ft. tile drain was tapped and allowed to run into an artificial reservoir. This eventually supplied plenty of water for the job.

Aggregates were shoveled from the subgrade and wheeled to a 21E Koehring paver.

The striking off and finishing was done by hand. The average per day was 407 lin. ft., with a maximum run of 600 ft. Total yards laid, 47,105.

It may be of interest to know the number of days no work was done. Paving operations began June 11 and ended September 2. During that time there were 58 days on which concrete was poured. All fractions of days were counted as whole days. The number of days no work was done was 14, that is to say, 20% of the time available for paving was lost, due principally to rain.

The pavement was laid for $2.26 per sq. yd., divided as follows:

	Per sq. yd.
Cement in place	$0.738
Fine aggregate in place	.316
Coarse aggregate in place	.728
Joint material	.015
Mixing and placing	.292
Water supply	.047
Sundry costs	.066
Administration and preliminaries	.062

In Rock county the operations were a continuation of the previous year's work. The rough grading ahead of the mixer was done for 82c per cu. yd. Culverts were constructed for $15 per cu. yd., exclusive of cement and steel, which brought the total cost up to $19.12 per cu. yd. All aggregates were taken from local pits, four of which were being operated. This afforded a means of operation so that the maximum haul at any one time was less than 2½ miles.

Gravel was excavated with a drag line scraper to the crusher. By passing the sand to the elevator direct, using a grizzly, the crusher was able to handle the material at all times. The material was screened and deposited in bins at a height such that when the chutes were opened the sand and stone filled the hoppers directly above a five-sack stationary Lakewood mixer. These hoppers discharged directly into the mixer. The mixed concrete was discharged into batch boxes on cars running on industrial track. When loaded, these cars were hauled to the road by a six-ton gasoline locomotive. Four trains were in use, with five cars per train, using three locomotives in all. The batch boxes were lifted from the cars by a Little Giant road crane, and the mixed concrete dumped directly on the subgrade. When placed it was struck off and tamped with a Lakewood finishing machine, but the final finish was given by hand with a roller and belt.

One of the interesting features on this job was the operation of the industrial track on 600 ft. of 10% grade. This was made possible by hauling the train to the base of the hill with one engine. The train of cars was then pulled to the top by a hoist, from which point it was again pulled with an engine. Another feature was the saving made by shaking cement sacks with a centrifugal sack shaking machine. The total amount of saving was $528.38, or approximately 1% of the total cost of the cement on the job. Or, in terms of cement, one sack of cement was reclaimed from every one hundred sacks emptied.

It may be noted here that operations will be continued next year on this work, with some changes, the main one being that dry batches will be hauled.

Paving operations began May 5 and ended on October 18. During that time seven miles were paved, or 73,656 sq. yds. The maximum run in one day was 593 ft. Progress was steady on this work while they were running, but a great deal of time was lost during the season by moving from one pit to another. This, however, resulted in a saving due to the shortening of the haul of material. The number of days lost due to moving was 27, and the number of days idle due to other reasons was 20. The total number of days of operation was 105. The paving was laid for $1.87 per sq. yd., made up as follows:

	Per sq. yd.
Cement in place	$0.880
Aggregates, fine and coarse combined	.285
Joint material	None
Mixing and placing	.228
Water supply	.061
Hauling mixed concrete	.308
Sundry costs	.098
Administration and preliminaries	.015

The accompanying table shows the detailed cost of operations on these five jobs. These should be of very great interest, as they were taken very carefully by a trained engineer, who gave his entire time to assembling this information. The accompanying charts show graphically some of the cost information given in the table.

It will be noted from the charts that no great saving can be expected from anything except the materials. When the cost of cement, sand, coarse aggregate, mixing and placing is removed, practically everything else is eliminated. In fact, it will be noted that the greatest possible saving can probably be made in the sand and coarse aggregate prices.

A study of the three charts accompanying this article is food for considerable thought.

The detailed cost table enables anyone knowing the conditions of the job to study where there is the best chance of making a saving on a similar job. It will also enable a contractor or municipality to determine what kind of cost information is the most desirable. That is, which items they desire to keep on an ordinary

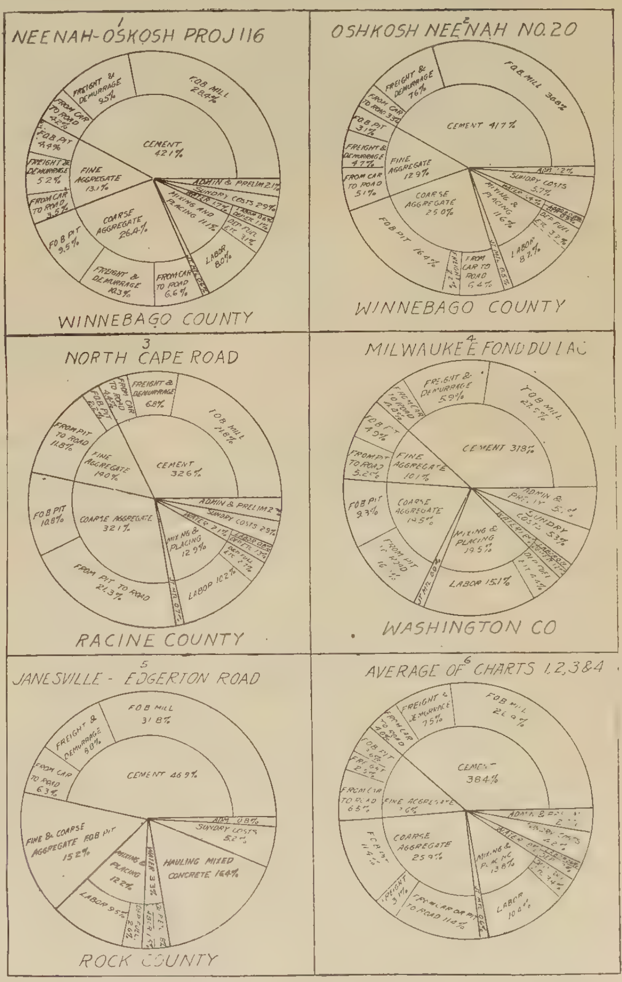


Fig. 1—Distribution of Day Labor Cost on Five Wisconsin Roads, Expressed in Per Cent of Total Cost

job, for it must be admitted that the ordinary job cannot keep costs quite as much in detail as these under discussion.

There is somewhat of a similarity between the two charts, one being divided on the basis of costs, and the other on the basis of per cent. Either one brings out very strongly the fact that the materials are the predominating items. In other words, if the cost of water, sundries, and administration was cut in half, the total percentage of saving on the job would not be very material. If the cost of mixing and placing was cut down one-third, which would be a very considerable percentage, the saving on the total job would not be very startling. However, if any great percentage is cut off from the aggregates, or from the cement, there would be almost a like percentage cut from the cost of the road. In other words, these charts show that the greatest time and effort should be placed on obtaining fine and coarse aggregate, because the cement item is fairly well established and is quite uniform in the various localities.

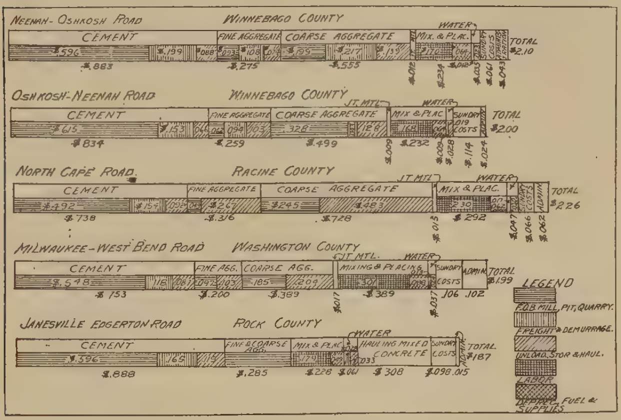


FIG. 2—DISTRIBUTION OF PAVING COSTS ON DAY LABOR CONSTRUCTION—FIVE WISCONSIN ROADS—EXPRESSED IN DOLLARS PER SQ. YD.

Because of the fact that this question of material prices is the most variable quantity, the Wisconsin Highway Commission undertook jobs with various methods of supplying the sand and coarse aggregate. This is noted in the description given of these five jobs, some of the material being shipped in from commercial plants, some produced in local gravel pits, and one a local quarry operation.

It will be noted that the Rock county operation, which was the cheapest insofar as the material was concerned, being 28½c, was a local pit operation. It must be borne in mind, however, that on this particular job the hauling was done after the material was mixed, and therefore the hauling price comes in the mixing and placing.

A study of these charts will also show that the smaller items, such as water, joints, mixing and placing, etc., ran quite uniformly throughout all the jobs, with the exception of the Washington county job, where the mixing and placing was extravagant.

The percentage chart is also interesting from some other standpoints. For instance, on a shipped-in job, such as the first Winnebago county job, or Project 116, the coarse aggregate was 26.4% of the cost of the job, and of this the freight alone was over 10%, or over 20c per sq. yd. on the job. Of course, the cement item varies on these jobs, because there was a slightly different mix used, depending upon the kind of materials available. These mixes varied from 1:2:3½ to 1:2:4.

In conclusion, the Wisconsin Highway Commission believes that with cost data and charts, such as are shown here, its engineers are in a much better position to pass intelligently on bids they receive on work in the state, and also to determine the materials that should be used, and also to appreciate the importance of freight reductions, material price reductions, and to realize that the labor element alone is not of such great importance, that is, the labor element on the road itself.

How's Business?

Current business conditions continue to point to a steady improvement of industrial activity. Among the important factors most frequently mentioned by financial authorities are the undoubted improvement of the foreign situation, the success of measures taken to relieve domestic unemployment, cheaper money, easier credits, better condition of the railroads, and steady, though uneven, decrease in commodity prices. The bond market—a generally reliable barometer—continues to rise, and that's a good sign.

Demand for goods on the part of the consumer continues, but buyers are very discriminating and sellers look for a highly competitive year.

The Federal Reserve ratio is about 75, as against 48 a year ago—a mighty big improvement.

Factors that continue to hamper business are the contraction of foreign markets for our surplus manufactures, threatened coal strike, unliquidated condition of labor in many classes, and the perilous condition of the farmer, practically taking him out of the market.

All in all, a steady improvement of business is looked for throughout the year, with some fields approaching normalcy faster than others. Authorities agree that the construction field is due for a banner year. The highway improvement program alone guarantees an immense amount of work, and the consumption of an enormous quantity of supplies and equipment.

Rural construction is holding back, but in the cities a very active building winter is being experienced, with prospects for steadily increasing activity as weather moderates.

December building contracts let totaled 98% above December, 1920—in fact, registered the highest total of any December in history, except December, 1919.

Building for the entire year of 1921 fell only 8% below 1920, quoted in terms of dollars, which would mean an actual increase over 1920, when lowered costs are considered.

Of the 1921 total, residential construction accounted for 37%, public works 19%, business buildings 14%, educational buildings 10%, industrial buildings 7%.

F. W. Dodge figures for January indicate that residence construction accounted for about half the building contracts awarded in the first month of the year, and prospects for the entire year promise great activity in highway improvements, residences and business buildings.

Construction materials are not fluctuating much in price. Labor is still inflated. The opinion seems to be general that building costs, which are still quite a way above pre-war levels, are too much out of line with other prices.

Next month—a complete account of the American Concrete Institute Convention.

Illinois-Wisconsin Concrete Pipe & Tile Co. Plant at Beloit, Wisconsin

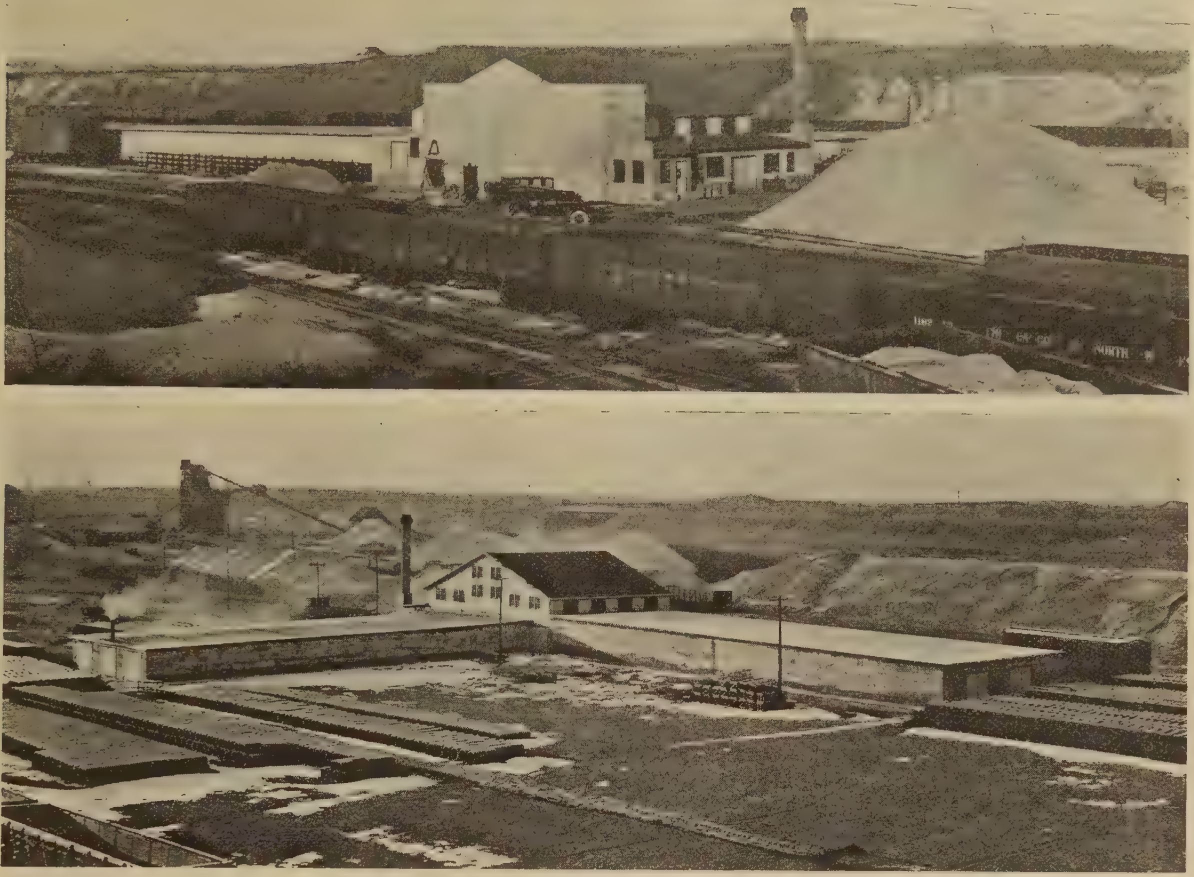


FIG. 1—THE NEW PLANT OF THE ILLINOIS-WISCONSIN CONCRETE PIPE & TILE CO., AT BELOIT, WIS.

The plant of the Illinois-Wisconsin Concrete Pipe and Tile Co., at Beloit, Wis., has only recently been put into operation. It represents modern ideas in handling raw materials and finished products and in this respect has features of special interest in the layout of the plant and in several items of its equipment.

The plant is near the pit site of the Atwood-Davis Sand & Gravel Co., whose main offices are in Chicago and which is in reality the parent company. Charles E. Richardson of the Portland Cement Association, is to a considerable extent responsible for the promotion of the new plant and for many details in its construction. The operation of the plant is under the management of G. B. Harker.

The raw material supply which is the basis of the enterprise is aggregate of a very high quality. Gondola cars from the pit are unloaded by a clamshell bucket operating from a locomotive crane. There are four main bins for the storage of aggregate in various sizes. Each of these bins is 10 ft. by 14 ft. by 24 ft. high. In the No. 1 bin is material passing ¼ in. screen; No. 2 bin, material from ¼ in. to ⅜ in.; No. 3 bin from ⅜ to ¾ in., and No. 4 bin ¾ in. to 1⅛ in. A fifth bin is for the storage of coal.

These bins feed near the bottom onto a horizontal conveyor belt through hand controlled gates. The conveyor belt in turn feeds to an elevator which puts the material into auxiliary bins in the top of the plant. There

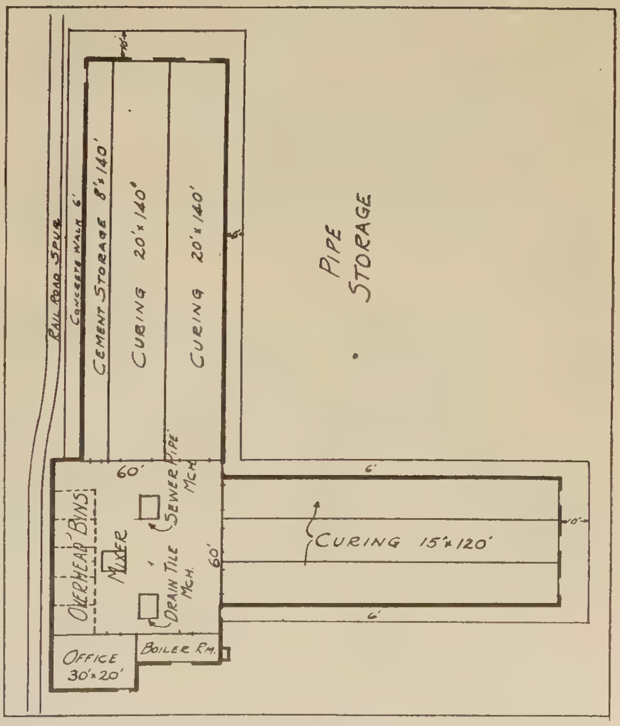


FIG. 2—LAYOUT OF PLANT AT BELOIT, WIS.

are three spouts from the top of the elevator so that material may be loaded into any one of the three. From the auxiliary bins the material feeds down chutes to measuring boxes which are set on pins and may be so gauged as to take as many pounds of material as needed for the particular mix in use. These boxes dump directly into the open top of the No. 14 Blystone mixer.

The cement is received in bags and unique storage is provided for three carloads. In the long, narrow space marked "cement storage" on the plan there are two 24-in. tracks. The floor on which they rest is about three feet above the floor level of the rest of the plant. From these tracks, a transfer track swings out to the open door at the far end of the storage space so that a car to receive 40 bags of cement for its load may be filled directly from the box car. This truck is then shoved in at the door of the plant, turned on the transfer, and sent down towards the mixer end of the plant. Employing these cars with a capacity of 40 bags each, the two long tracks will hold three ordinary carloads. The cement longest in stock is always nearest the mixer. The loading of the mixer is direct from the trucks. When a truck is empty it goes down a hinged switch track through a trap door and rolls back by gravity the entire length of the storage space, under the incoming tracks, on other tracks at a lower level, to the far end where the cement is brought in from the railway cars. Here it is picked up by a small crane and set onto the upper tracks. The Blystone mixer is located under the main material bins. In front of the mixer is a McCracken drain tile machine on one side and a McCracken sewer and culvert pipe machine on the other side.

The man operating the mixer dumps his aggregate from the measuring boxes directly into the mixer then the cement and turns on the water. The water is not measured, as the quantity varies with the moisture content of the aggregate and the mixer man is the arbiter of the consistency, which he tests from time to time by a piece of what they call in the plant, "slicking steel." This is simply a flat steel plate close by the mixer against which he rubs a handful of the mix to see if it trowels up to the proper consistency. To avoid the necessity of dumping the mixes in the usual way, a gate is made in the side of the drum and the revolving blades discharge the material. This goes into a hopper from which a man shovels the concrete into the buckets of an elevator that feeds into the hopper of the machine. It is at these buckets that the material is measured for the given size of product being manufactured.

The plant will make sewer pipe in sizes of 6 in. to 24 in. either plain or reinforced on a new improved McCracken machine and will make cast pipe in hand molds from 24 in. up, both plain and reinforced. Culvert pipe is made on the same machine by changing jackets and pallets.

An unusual thing about the new McCracken machine is that the packing equipment packs the concrete so thoroughly in the end of the pipe as to make it unnecessary to use a pallet when the fresh products are set off to cure. In the ordinary plant manufacturing bell end pipe the outlay for pallets is extremely large. Under ordinary conditions pipe are either left on the pallets for three days or else there is an excessive labor charge to remove the pipe from the pallets and turn them over in the curing room after the first day. Here the labor charge offsets the investment in pallets.

It has been found uneconomical to change the size of pipe made any oftener than is necessary, for while the machine itself may be adjusted in an hour or so to make a different size, the material feed has to be adjusted and the whole crew has to get into a new stroke, so to speak. So that if the plant is going to run economically for three days on one size of pipe it must at least have 1,000 pallets of that size, or 3,000 pallets of a size, if the pipe are to remain on the pallets for the full curing period. In making a large number of sizes it is figured that the investment in pallets is almost equivalent to the entire plant investment, except of course for the equipment.

Not only does this new machine make bell end sewer pipe which are removed in the jackets on a cart, turned over and set down on the spigot end when the jacket is immediately removed, but it is also making at the new Beloit plant a spigot jointed culvert pipe also without pallets. All these pipe are of the corrugated type. A 15-in. culvert pipe weighs 325 pounds. It is packed so hard that it is set down on the groove end of the pipe where it rests on a 7/8-in. edge without damage. It was discovered that for the larger sizes the weight was so great that the fresh product would not bear removal from the machine to the cart without deeper corrugations. New molds have been made with these deep corrugations and remain yet to be tried.

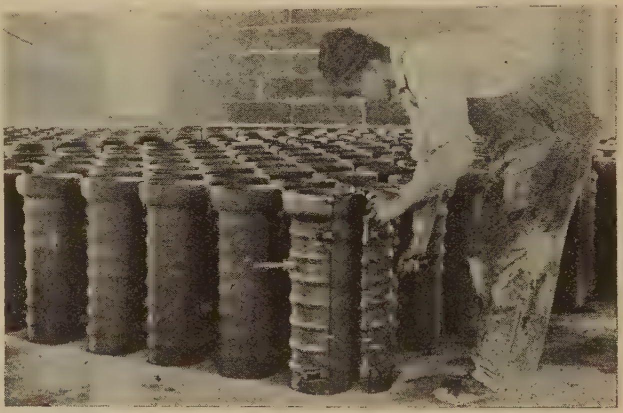


Fig. 3—Stripping Mold From Pipe Immediately After Removal From Machine

The pipe as manufactured are removed on the carts to the curing rooms as already mentioned, and when hard are handled entirely on lift trucks. It is for ease in handling the pipe in this way that concrete sidewalks have been laid all around the curing rooms, in addition to the concrete floors inside the curing rooms. Trailer loads of pipe are hauled about the yard and hauled a considerable distance from the plant by a Fordson tractor.

On a recent test of a 15-in. internal diameter culvert pipe made without reinforcing the product showed a strength at thirty days of 6,128 pounds per linear foot.

Cement bags as they come away from the mixer are put into a Wirth sack cleaner, 100 at a time,[1] and from 5 to 12 bags of cement are recovered per 1,000 sacks cleaned.

Operations in making sewer pipe are carried on by 14 men, as follows: 1 machine operator, 1 assistant, 1 mixer man, 1 man shoveling mix into elevator of machine, 3 cart men, 2 strippers in curing room, 1 foreman, 1 handy man, 3 yard men for emptying curing rooms and loading cars.

In making drain tile the crew has 10 men as follows: 1 operator, 1 assistant, 1 stripper, 1 mixer man, 1 man in front of mixer shoveling, 1 handy man, 3 yard men, and 1 foreman.

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[1] Joseph Wirth, Fond du Lac, Wis.

Apollo Steel Co. Builds Cinder Block Houses

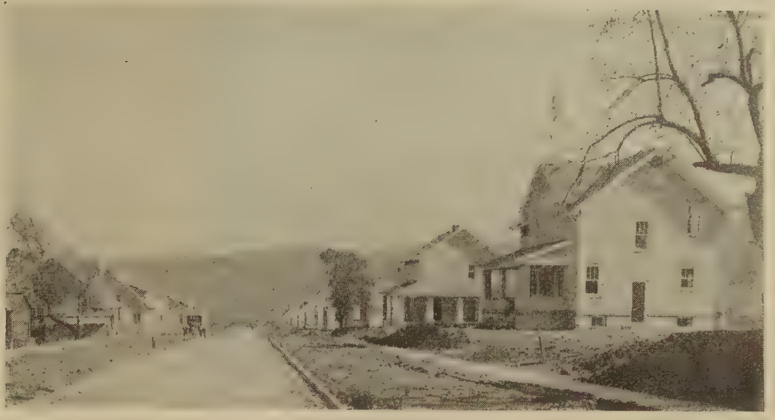


Fig. 1—Apollo Steel Co. Builds Sixteen Cinder Block Houses for Employees at Apollo, Pa.

In providing homes for employees, the Apollo Steel Co., Apollo, Pa., chose Straub cinder blocks for outer walls from footing to roof, and so far 16 houses have been built, in which the interior plaster has been applied direct on the block without furring, stucco being applied as a seal coat and a finish outside.

The Apollo Steel Co. in 1919 bought about 216 acres of land on the right bank of the Kiskiminitas River, less than one-half mile north of its works. This land is traversed by the Apollo-Leechsburg trolley line, is fairly level, and well suited for manufacturing plants, the river at this point carrying an abundant water supply, and railroad facilities being available on the Conemaugh division of the Pennsylvania R. R.

When the steel company in 1920 enlarged its plant and private enterprise in home-building was at a standstill, with no homes available in Apollo, the company prepared plans for 16 houses, to be built of substantial material.

After preliminary investigations, in which frame, brick and concrete materials were considered, it was decided to use the cinder concrete block manufactured under the Straub patent, as the most desirable material for the outer walls from footing course to roof. There were several reasons for this choice, and these and other details of the work are outlined by Henrik Owesen, the company engineer, under whose direction the work was done.

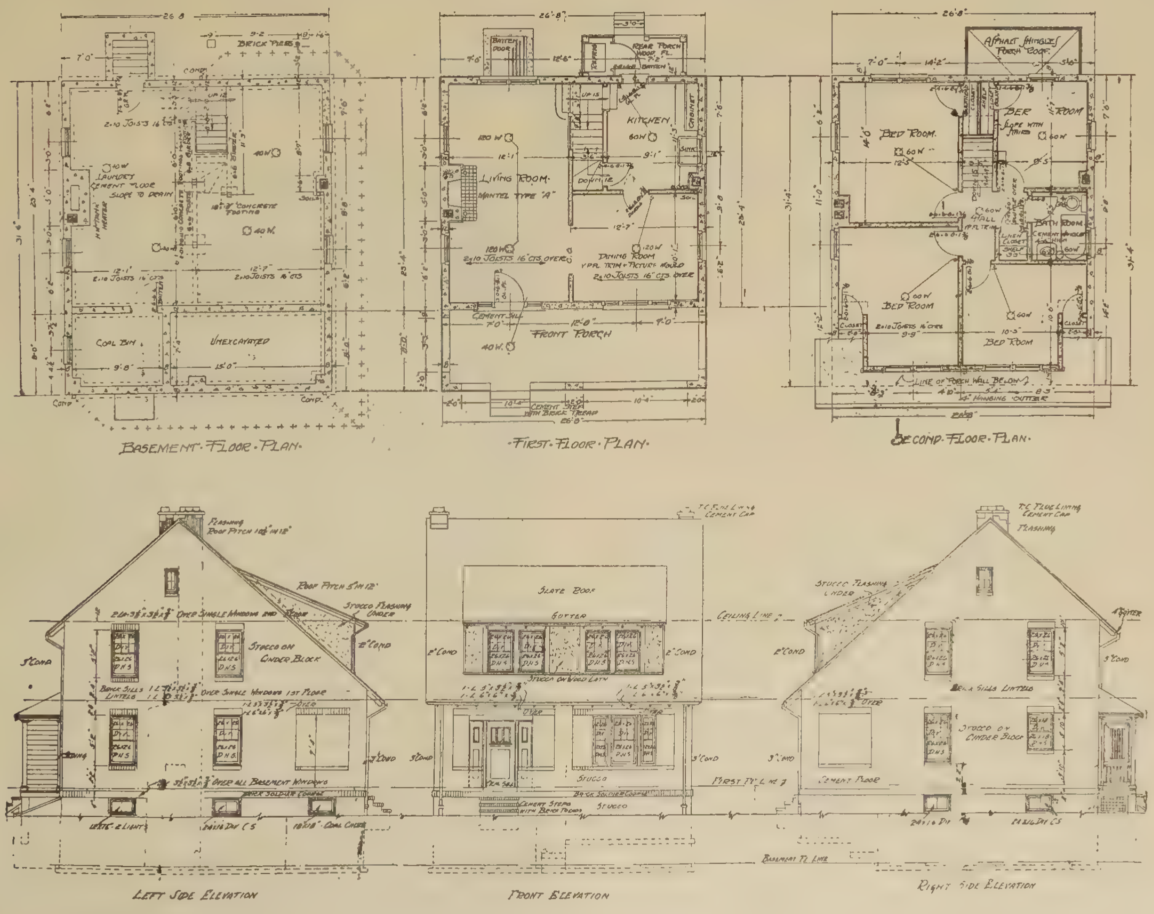


Fig. 2—Typical Plans and Elevations, Apollo Steel Co. Houses

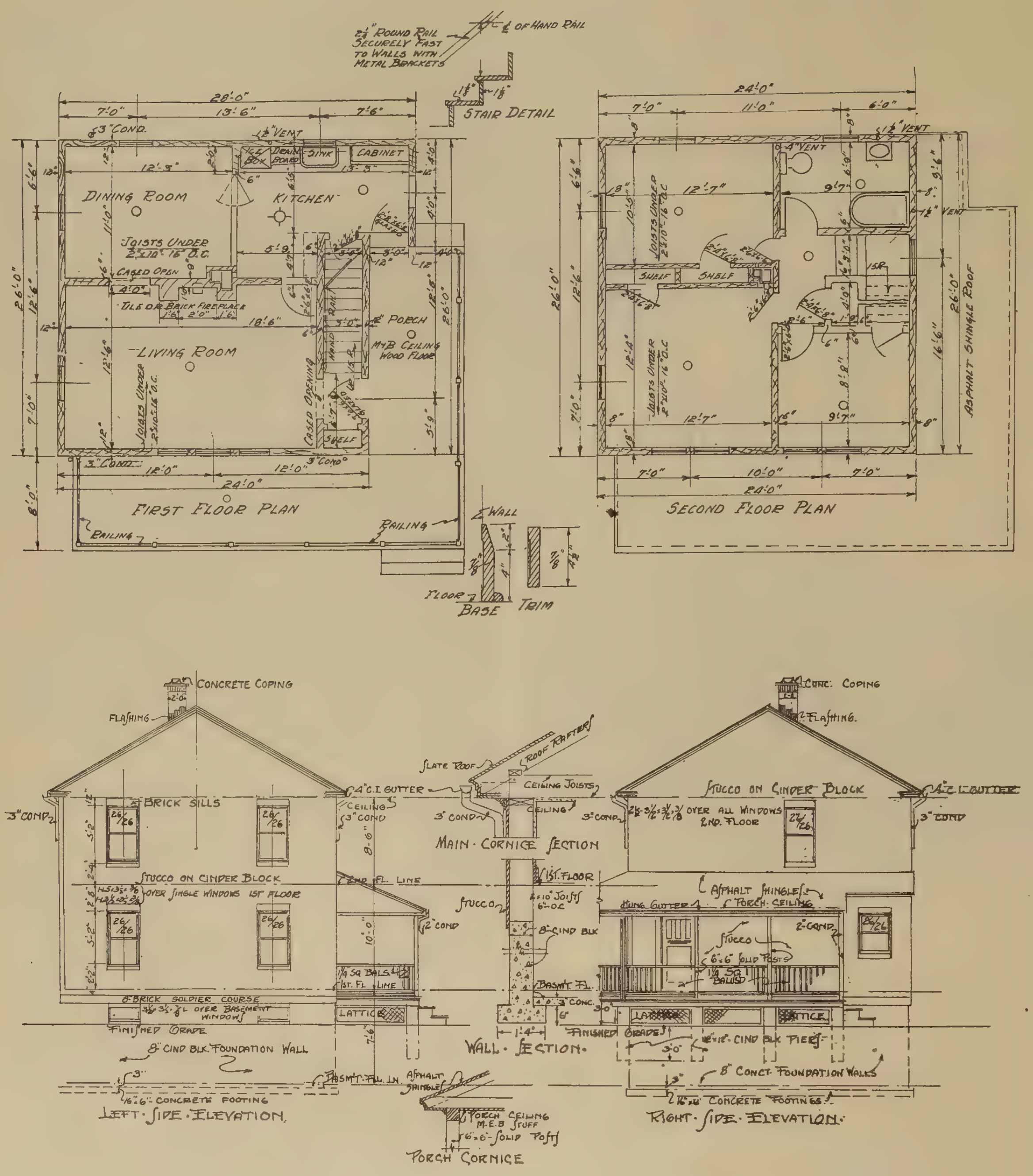


Fig. 3—Plans, Elevations and Sections of One of the Apollo Steel Co. Cinder Block House Designs

"Permanence without much expense for upkeep; economy, as the only material on which it was necessary to pay freight was cement, the cinders being obtainable as a by-product from the nearby plant; pleasing appearance by varying the color of the stucco and by using red brick for sills and lintels; damp-proofness, as the cinder concrete, with its large pores, does not permit penetration of atmospheric moisture to inside of wall; nails for inside finish are easily driven in the cinder concrete without harming either the block or the nail. Cinder block also meant a saving of 30 cents per sq. yd., as the plaster could be applied directly upon the cinder concrete block, without the use of lath.

"Last, not least, the cinder concrete block were far quicker to lay than any other blocks or bricks, the weight being such that the units could be lifted in one hand; in fact, three bricklayers kept ahead of a gang of 14 carpenters.

"The actual construction did not get well under way until October 1, and as it had been decided to stucco the outside, Kellastone was selected as the winter drew near, as the magnesite stucco could be worked at a lower temperature than portland cement.

"The stucco was applied during December and January, the plaster on the inside walls at the same time, direct on the block. The cellar walls and foundation walls to the belt course have been covered with one-half inch of cement mortar.

"Each of the houses has two rooms and kitchen downstairs, and three or four rooms and bath upstairs with a finished stairway to the attic. The ceiling heights are all 9 ft. 3 in., respectively.

"Every room upstairs has windows in two walls, thus assuring good ventilation. Furthermore, two chimneys were built to provide outlets in as many rooms as possible for flue connections.

"The development is served by a complete sewage system, with an individual septic tank at each house.

"Concrete street paving 1,800 ft. long, 18 ft. wide, and a 4 ft. sidewalk on each side of the street were constructed and when this was completed the Steel company went ahead with the improvement of another street for future development. In this way almost seven-eighths of a mile of concrete street has been built, opening up 110 lots.

"This development has added a new suburb to the old town of Apollo, and with new factories opening up, should provide good opportunities for the employees to become owners of their own homes—both lots and houses being sold on an easy payment plan."

The president of the company is A. M. Oppenheimer, and three of the directors, Messrs. Gallagher, Pollock and Shroyer, live in Apollo, and in this way are directly interested. The engineering and the purchase of all materials were taken care of by the Apollo Steel Co.'s engineer and purchasing agent, respectively.

How to Cut Concrete Sewer Pipe

By D. R. Collins

Because well-made concrete sewer pipe are so tough and do not easily fracture or chip, they can be readily cut to necessary lengths in the field. The accompanying pictures were made in Portland, Ore., where pipe made by the Concrete Pipe Co. were being placed in a sanitary sewer. A sharp pick, a heavy axe, and a medium-weight hammer were the only tools used. Two workmen required approximately 20 minutes to cut a section of 24-in. pipe.

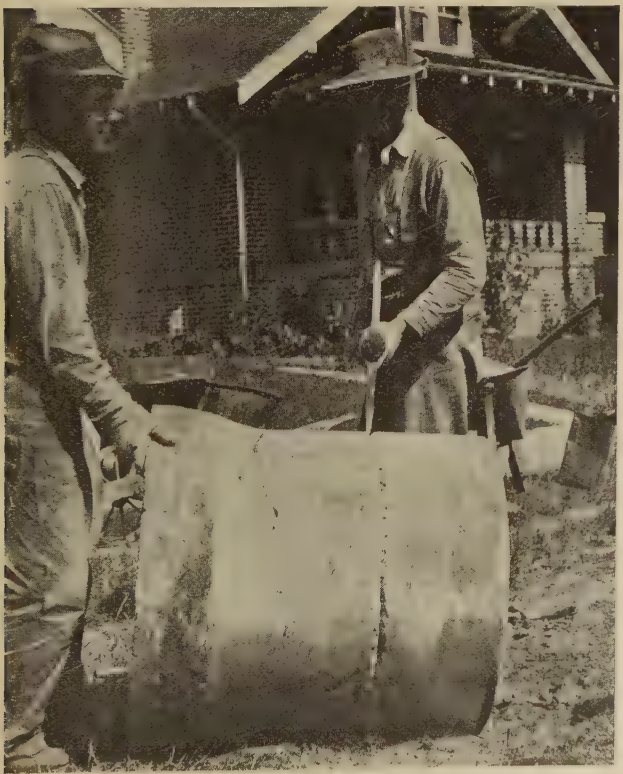


Fig. 1—Cutting Concrete Sewer Pipe

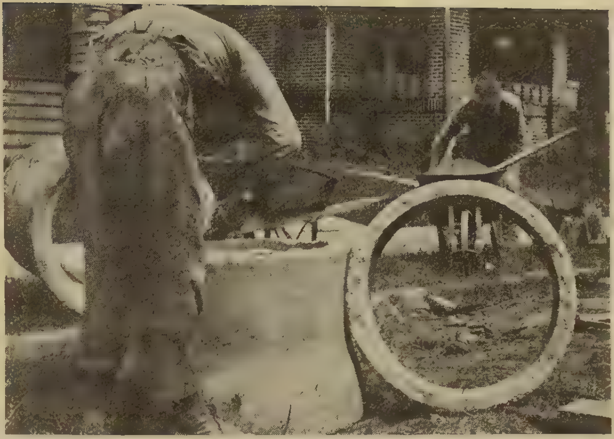


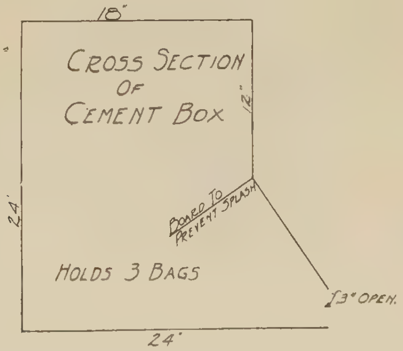
Fig. 2—A Good Pipe Makes a Clean Fracture Like This Without Shattering

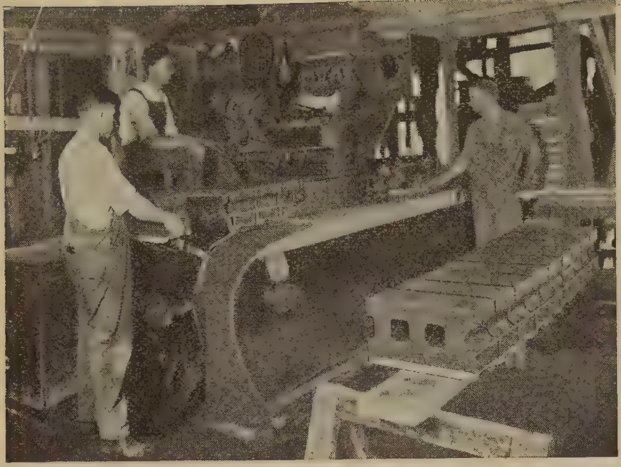
One man holds the pipe, turning it slowly, while the other man picks the surface on a line which has already been marked. When the pipe has been picked to a depth of from one-half to three-quarters of an inch, all the way around, it is then turned up on the bell end and one man holds a heavy sledge or axe against the outer surface along the line which has already been picked. The other man then takes a medium-weight hammer and firmly taps the inside of the pipe shell opposite the line on which it has been picked on the outside.

This tapping evidently forms a hair crack through the pipe and makes it very easy to cut. The pipe is then turned over on its side and is struck a firm, but not hard, blow with an ordinary axe, the blade striking in the groove in identically the same manner in which the iceman picks a chunk of ice and then cuts it with an axe. The pipe is struck with the axe in about five or six different places around the circumference, and soon begins to yield. A few firm blows will then separate the two pieces. The illustrations show very clearly how evenly the pipe can be cut.

Cement Box Gauges Shovelfuls

I use a cement box like the sketch. My mixers are small ones and are fed by scoop shovels. This box makes it possible to get the right amount on the shovel each time, and the same amount of cement in each batch. —A. C. Fish, Ottawa, Kansas.





THE DEBAY BLOCK MOLDING MACHINE

A New Kind of Block Machine

The Debay block molding machine,[1] invented by G. C. Debay, Springdale, Pa., is new equipment introducing mechanical operations new in concrete block making. The novel feature is an endless chain carrying 28 separate mold boxes, passing in turn under the feeding and compacting mechanism. The equipment was designed for economy through rapid production—5,000 block per eight-hour day.

Twenty-eight separate castings, carrying the mold boxes, are linked together by steel pins, on each end of which are mounted small flanged wheels or rollers. These rollers, when passing under the packing unit, ride between two rails, one above and one below, which guide the molds accurately during active operation, and reduces friction to a minimum. These rollers also mesh with the teeth of four large sprockets, two at either end of machine. The two sprockets at the front of the machine are geared to the main drive, and serve to rotate the mold chain, similar to the caterpillar tread on a tractor.

The molds, of combination type, giving quite a variety of blocks, are bolted to the chain castings, making them easy to change. They are made up of steel plate and bar construction, and are so built that the top of the back wall has two hinged members. These, when open, allow them to clear the rods by which the stationary core-bars are anchored.

After the molds have cleared the core-bar anchor rods, the hinged members are automatically closed, the molds moving forward, making a complete circuit. After the molds pass down over the front sprockets, the hinged members are automatically opened.

The packing unit, which is directly above the mold unit, encloses the ends of the molds during the active operation, thereby making a sort of moving steel box, into which the concrete is packed. The packing unit consists of a batch hopper, into which concrete is dumped just prior to the packing process, rotary packers, rotor, and three feed control gates, which are adjustable, as a group or individually, to allow just the proper amount of material for a good solid block to be pulled forward by the molds and packed down tightly by the rotor. The rotor, being geared to revolve at the same speed as the molds, has great packing power. The packing is also aided by tapered core-bars. A trowel plate finishes the packing operation.

A chain lubricating unit enables the operator to take care of the lubrication of the mold chain by simply manipulating a lever. A block counter facilitates keeping manufacturing records. The machine requires a 3 h. p. motor, which is mounted on a bracket at the right side of the machine.

The operator stands on a platform at the left side of the machine, and has complete electric control of the whole mechanism.

Wooden pallets are fed into the machine at the rear and form a sort of false bottom for the mold. The pallet is removed with the block and serves as a handling medium until the block is cured. It is proposed to use a variety of facings applied to the pallet before inserting in machine.

In setting up the Debay machines for operation, it is proposed by the manufacturers that plants will be specially laid out and equipped to handle materials to and from the machine. It is proposed to use 14 cu. ft. Blystone mixers, discharging alternately to supply mixed concrete; to use a comprehensive installation of bins, screens and conveyors suited to the particular plant location and material supply, and to install also complete off-bearing equipment at the delivery end of the block machine—first a conveyor belt, to a rack, and by means of lift trucks to curing rooms.

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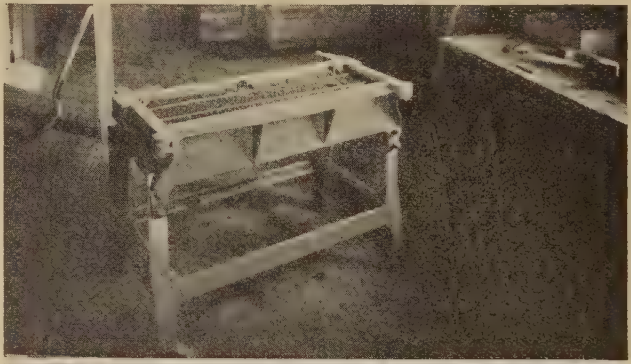
[1] Otkon Mfg. Co., New Kensington, Pa.

Hahn System of Wall Construction

The Hahn system of wall construction makes use of precast concrete lumber units, 2 in. by 12 in. by 36 in. They are reinforced longitudinally with two 3/16-in.



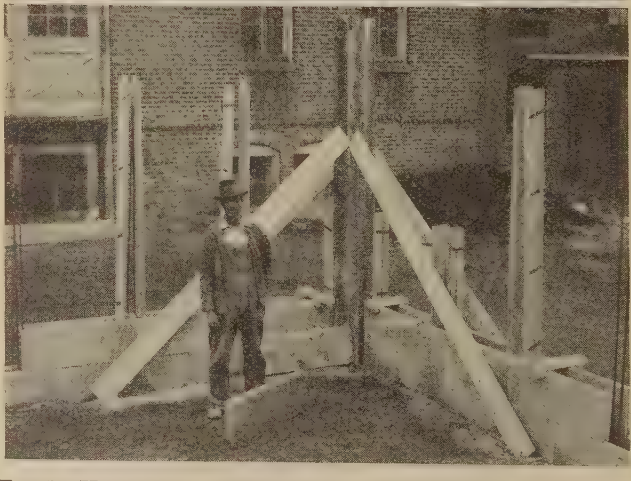


FIG. 1—HAHN PRECAST LUMBER MOLD
FIG. 2—SET-UP FOR WALL CONSTRUCTION

reinforcing bars, and have wire eyes projecting from the concrete in slight cutouts on one edge near the ends and at center of the board. These provide means of fastening the boards together with tie-wires in double wall construction. The loop in the middle of the block permits a broken joint.

The boards are hand made. The mixer discharges into the hopper table at the back of the mold. A pallet is laid on the table and the mold closed around it. The reinforcing bars and wire loops are put in their proper position, green concrete shoveled in, tamped and smoothed, the mold opened and the board carried on the pallet to the curing room.

The cost of manufacture as given by the inventor of the system is as follows:

Cost for 100 Boards, 2 in. x 12 in. x 36 in., Containing $\frac{1}{2}$ cu. ft. of Concrete and Weighing 70 lbs. Each

Sand at $1.70 per cu. yd.	$3.66
2 3/16 in. reinforcing rods for each board, at $0.05 per lb.	1.66
Bending wire	0.25
Cost of wire loops	0.20
Cement, at $2.25 bbl	7.33
Labor (Foreman, $5.00; Laborers, $3.50 per day; 300 boards in 9 hours)	4.08
Yardage and Overhead	2.50
Breakage	0.20
Total	$19.88

Or $0.20 per board.

Walls are started on a monolithic footing. Reinforcing rods are inserted to act as reinforcement for the studding, which is poured as the walls progress. Frames built up of 2 in. by 6 in. timbers are placed at the corners to insure line and to brace them until the concrete has hardened. Collapsible forms, placed between the walls to keep the correct distance between them and to form the studding, are then trued and attached to the corner frames by wooden strips. This work is shown in Fig. 2. The concrete boards are then laid and tied with wires through the studding.

Three rows of boards are laid at a time. If desired, or considered necessary, clamps are put across the top of the boards to hold them to true position. The studding is then poured and the entire process is repeated. When an offset is desired to allow for the cross beam for joists, a 6 in. thick form is used for the studding The cross beam is secured by bolts through the studding.

The inventor of this system lays special stress on the fact that walls built by this system have a row of reinforced concrete posts or studding of sufficient strength to withstand necessary stresses and the concrete lumber, although adding to the strength of the wall, need not be considered.

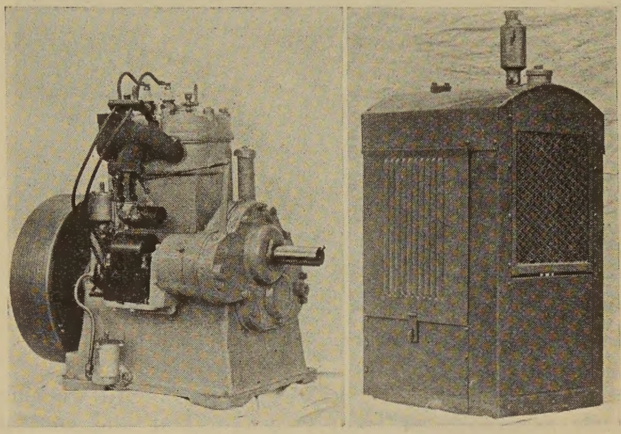
In single wall construction the forms for studding are three-sided and not collapsible. They must be made by the contractor. A furring strip is placed on the rear board, with nails driven into it to extend into the concrete of the studding. The connecting wire is secured through holes in the rear board of these forms and bent to secure it. When the studding hardens the ends of wire are clipped off and forms removed.

The patents on this system are owned by the Hahn Concrete Lumber System, Decatur, Ill. The molds and collapsible forms are not sold, but leased to local contractors, who are charged a royalty on the number of cubic feet of concrete necessary to complete the job by this system.

A Two-Cylinder Gas Engine

A new two-cylinder, four-cycle, vertical type engine, with a $3\frac{1}{8}$-in. bore and a $4\frac{1}{2}$-in. stroke, that can be used economically on any equipment requiring from three to eight horsepower, has recently been developed and put on the market by the Le Roi Co., Milwaukee, Wis., makers of heavy duty engines.

A novel feature of this engine is the fact that the drive may be taken off at three places. It can be taken off the front or rear of the engine speeds, or can be taken off the camshaft at one-half engine speed.



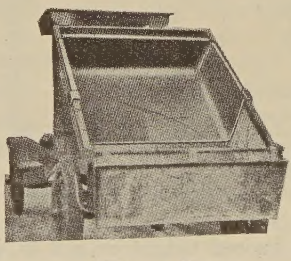
Le Roi Two-Cylinder Engine for Construction Equipment

The design of this engine follows closely the proven four-cylinder engine manufactured by this company. The various features of the engine and the materials used were selected with a view to dependability.

The engine can be furnished completely equipped with all accessories, including fuel tank, radiator, fan and fan belt, ready to run. It is fully enclosed so it may be operated on equipment without the necessity of housing it. Equipped and enclosed in this manner it only weighs 325 lbs. This engine also may be purchased without accessories and other equipment, and in this condition the engine only weighs 260 lbs.

Scooperout for Truck Bodies

The Anthony Scooperout[1] is a device for cleaning thoroughly the bottom and sides of dump trucks. It consists of a sheet metal lining that falls towards the rear of the truck as the body is elevated, scraping out all the concrete or other material that clings to the body, and finally cleaning itself when it hits the specially arranged shock-stops at the body's end.



Anthony Scooperout for Truck Bodies

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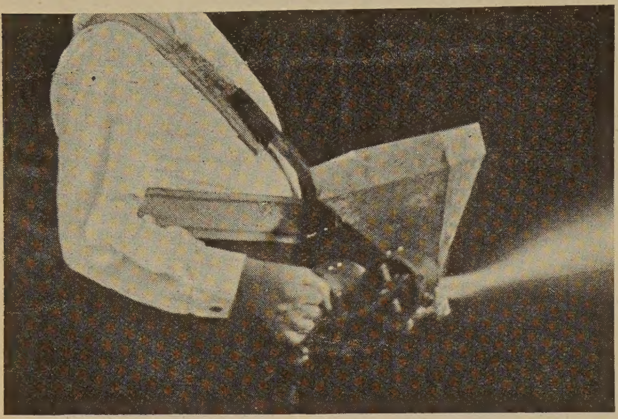
[1] Anthony Co., Streator, Ill.

New Stucco Machine

A new device for mechanical application of stucco or any like material is being manufactured by the Stevens-Niles Manufacturing Co., Chicago. The machine consists of a hopper, a throat with an agitator to help the flow and an electric fan. The device is made of cast aluminum, and weighs about 30 lbs. All working parts are protected from excessive wear and contact with cement.



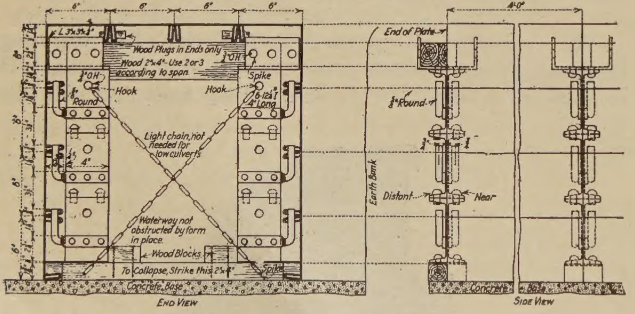
Stevens Air-Electric Stucco Machine

The machine is suspended from the shoulder of the operator, who holds the nozzle in his hand. An attendant keeps the hopper full. The motor is controlled by a switch on the handle. Producers say the machine will finish 400 sq. ft. of wall per hour.

Bilger Culvert Form

The Bilger Flat-Top Culvert Form,[1] designed by H. E. Bilger, formerly road engineer of the Illinois State Highway Department, is made of steel plate, angles and other structural steel. It contains no cams or springs, and such parts as break can easily be replaced by any blacksmith.

The form consists of two elements, center sections or uprights, and the cover plates. In erecting the form, the concrete base is first poured and the center sections built up to the desired height on a 2 in. by 4 in. timber. These sections are standard 6 in., 12¼ lb. I-Beams, 4 in. long. Holes are punched in the upper and rivets welded to the lower flanges, so that lateral movement is prevented by the sections fitting together. Hooks are welded on the sides of these sections, that fit into holes on the cover plates. The cover plates are 4 ft. long and are made of 14-gauge steel. The side and top plates are 6 in. wide, after being flanged 1¾ in. along each edge for stiffness.



Details of Bilger Flat Top Culvert Forms

Each flange is of double thickness and strength, for the plate is bent completely back upon itself before the flange is turned, which forms a round edge that makes it easy to handle. These flanges are symmetrically punched to receive the hooks on the centers.

When ready to knock down the form, the 2 by 4 beneath the centers is knocked out. This lets the sections fall, disengaging the hooks from the cover plates. The cover plates can then be loosened with a hammer.

The cover plates are not fastened to the centers. They are engaged on the hooks and then slide down and make a tight joint that prevent leakage of mortar.

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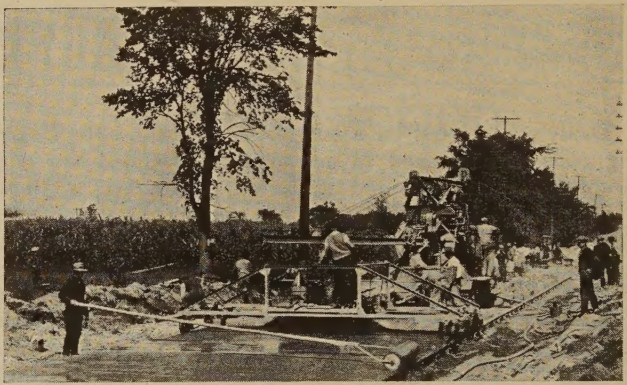
[1] Highway Culvert Form Co., Chicago, Ill.

Maxon Road Finisher

The illustration shows the Maxon Concrete Road Finisher[1] in action. The frame is built of steel angles. The strike-off, composed of two members in the same plane, which reciprocate in opposite directions, is driven positively by a double eccentric. The tamper extends the full width of the road; is placed below the center of gravity, and is actuated by compressed air. The belt float is at the rear; the length of stroke and its pressure on the concrete are adjustable. The engine is completely housed. The operator is seated in the center, with all controls within easy reach.



Maxon Concrete Roal Finisher at Work

Sidewalk Joints

Here in Renton the city engineer had us cut the concrete walk that we were laying, every eight feet. I found that this made a poor job, as we first did it, as the axe we used never cut clean through the bottom course. I had three iron bars made, 6 ft. by 4½ in. These we insert in the walk at every 8-ft. mark, and when the bottom course has set up take the first one out and move ahead 8 ft., so three bars are sufficient to keep a small crew going. When tamping, just before putting the top course on, we fill the space left by the irons with sand, taking care not to have any sand on the bottom course when marking the surface. A joint will come over the sand joint; this is cut with an extension marker. This gives the walk a good chance to crack where it is not noticeable, and at right angles to the walk.—E. E. Duff, Renton, Wash.

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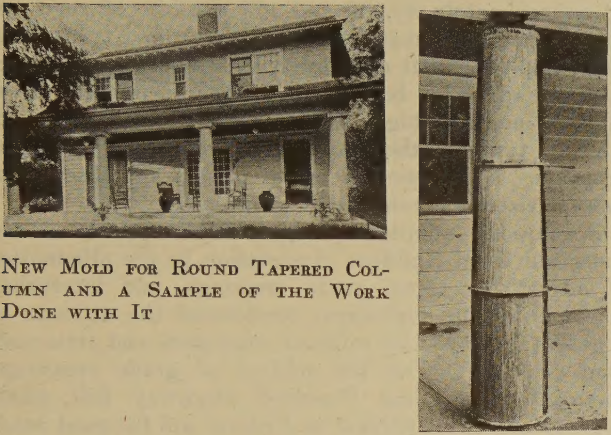
[1] The Maxon Co., Milwaukee, Wis.

Tapered Column Mold

The illustrations show tapered porch columns cast with the new adjustable Reichert tapering column or pergola mold recently developed. Columns shown are 16 in. in diameter at the base and 12 in. at the top. They are made hollow by placing 6 in. stove pipes in the center of the forms. This leaves a 5 in. wall at the base and a 3 in. wall at the top. Each column contains about 9 cu. ft. of 1:6 concrete. The cost of the material in each column was $3.00, and the labor, including setting up and stripping the metal forms and finishing the column with a brush coat of cement mortar, was $4.00, making a cost of $7.00 per column.



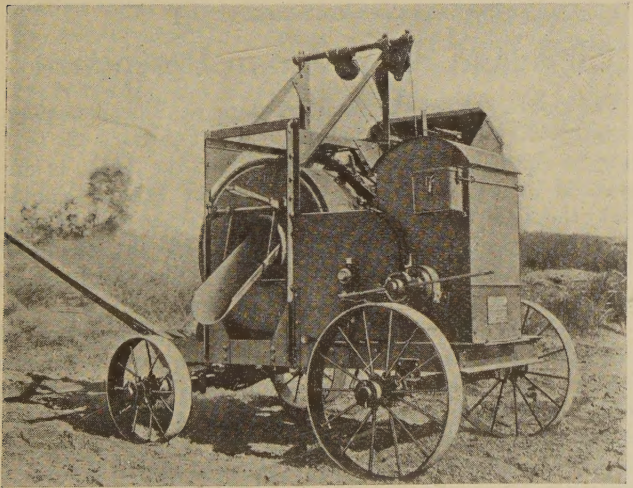
New Mold for Round Tapered Column and a Sample of the Work Done with It

A wood column of these dimensions could not be bought for less than four times this cost, while one made of plaster would cost about twice as much.

Austin Drum Mixers

Popular-priced drum mixers have been added to the Austin line. Heretofore Austin mixers have been of the cube design, the mixing being done without the aid of blades or paddles, simply by throwing the batch from plane to plane with a force varying with the speed of revolution. This necessitated construction of unusual strength.

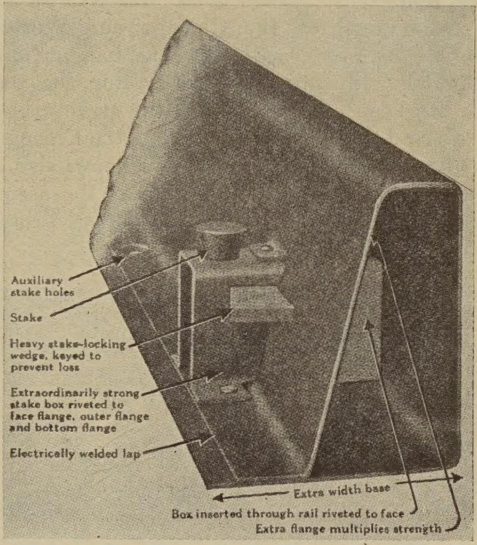
In the new drum-type mixer, the customary elevating mechanism in the interior is used. The consequent freedom from unusual strain has enabled the Austin people to turn out a mixer at a much lower price than before, and meet the demand for a moderately priced mixer, equal to ordinary demands. The mixers will be supplied in all standard sizes, from one-half bag to two yards. The principle will be used to produce a second line of Austin pavers.



Austin Moderately Priced Drum Mixer

Metaform Road Rail

A distinctive tubular shape marks the new Metaform road rail[1]. It is made of 11-gauge steel, electrically welded. The tubular form is to supply strength and rigidity so that the unit does not bend or buckle, and become distorted by finishing machines. The stake boxes give the stake a bearing on both the top and bottom of the rail. They are wedged in to take up all play. The extra width of the bottom flange, 5¾ in., gives a greater area of bearing surface, which prevents sagging. The joints are sturdy and permit easy handling. The rails are entirely enclosed, so there are no recesses to fill up with concrete.


Auxiliary stake holes
Stake
Heavy stake-locking wedge, keyed to prevent loss
Extraordinarily strong stake box riveted to face flange, outer flange and bottom flange
Electrically welded lap
Extra width base
Box inserted through rail riveted to face
Extra flange multiplies strength

Metaform Road Rail

The rails are made up in sections 6 in., 7 in., and 8 in. high. The standard length is 10 ft.

Patching Concrete

In pitching shallow holes in concrete sidewalks, walls, etc., I have found it better to use lime water instead of plain water. Take as much lime as is considered necessary and slake it in enough water for the job in hand. Allow most of the lime residue to settle before decanting the lime water. Remove all particles of loose dirt, concrete, etc., from the hole to be patched and then wet it thoroughly with the limewater. Use a 1:2 proportion with limewater. Work it to a plastic consistency and then apply it to the hole to be patched. I have found that using lime water gives a more substantial and durable patch.—Carl A. Soderstrom, Denver, Colo.

Oshkosh Pavers—Oshkosh Mfg. Co., Oshkosh, Wis. 10-¾ by 7-¾, 11 pages and cover in two colors. This pamphlet describes and illustrates the Oshkosh 14 E Paver giving complete specifications as well as detailed descriptions of each part.

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[1] Reichert Metal Concrete Forms Co., Milwaukee, Wis.

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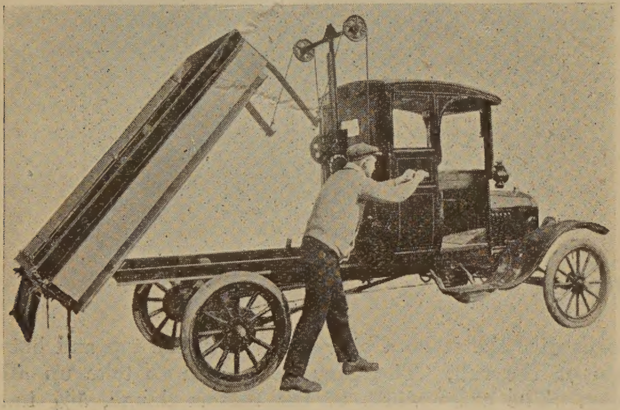
Cement Association Organizes Railways Bureau

Recognition of the pressing needs of railroads in maintenance and construction is shown by the Portland Cement Association in having just organized a Railways Bureau at its General Office in Chicago. This new bureau will facilitate service available to railroad men through the resources of the Portland Cement Association for compiling and presenting authoritative data on railroad uses of concrete. Railroad officials have long realized the value of keeping abreast of developments in concrete construction and will appreciate the better service contact they are thus afforded.

D. A. Tomlinson, the manager of the new railways bureau, is himself a railroad man. He was in the engineering department of the Chicago and Western Indiana R. R. for five years, where he had an unusually wide experience in railroad work. For the past two years he has been connected with the structural bureau of the Portland Cement Association at the Chicago office, and thus brings to his new position a knowledge of concrete and of the work and facilities of the association, in addition to an understanding of railroad problems.



Archer End-Dump Hoist Body

Archer End-Dump Body and Hoist

The picture shows the Archer end dump hoist and body for a Ford ton truck. It is hand-operated and is so designed that the dumping operation requires but thirty seconds. The body itself can be lowered by gravity in five seconds time, or can be held at any desired place by means of paul and ratchet.

The body is built of steel fitted with double acting tail-gate, with removable wooden flare boards, and can also be furnished if desired with special slide gate arrangement. Body dimensions are 7 ft. by 44 in. by 14 in. deep.

Pyramid Tile, Pyramid Tile Machinery Co., 434 Marquette Bldg., 140 So. Dearborn St., Chicago. A circular announcing a new type of interlocking, self-aligning concrete building tile with two series of air spaces intended to be laid up without mortar and be manufactured in three sizes or widths 4, 8 and 12 inches.

Plan Sheets put out by the Universal Cement Mold Co., present plan drawings, elevations and wall sections with a statement of quantities and estimated costs for the erection of house, described, using the universal molds in building double walls.

American Road Congress

The Twelfth American Good Roads Congress and Thirteenth National Good Roads Show, at the Coliseum, Chicago, January 16 to 20, under the auspices of the American Road Builders' Association, had an attendance of approximately 20,000 and 177 exhibits of road machinery, methods, materials, appliances, and transportation equipment, that overflowed the Coliseum and annex into two adjoining buildings. It was an impressive exhibition, and the bigness of some of the displays admirably typified the present American road building program. Many good technical papers and discussions characterized the convention program.

Resolutions adopted pledged the support of the American Road Builders' Association to the elimination of advertising signs, grade crossings, and interurban tracks from the highways; condemned the attitude of negation displayed by railroad companies and state railroad commissions on the subject of grade crossings; endorsed the pending Woodroff Highway Bill, which appropriates $100,000,000 as Federal aid for good roads annually for five years, beginning July 1, 1922; urged the Interstate Commerce Commission and the various state railroad commissions to put an end to present existing inequalities in freight rates on road materials; petitioned President Harding to take such action as may be necessary for the United States to become a member of the International Road Congress; pledged the association to work for efficiency and permanency in the personnel of all highway departments, and the elimination of partisan politics from highway construction; favored a pavement width of not less than 20 ft. for all trunk highways or roads carrying dense traffic. Hearty endorsement was given to the efforts being made by various committees to find a method of stabilizing subgrades and of ascertaining the relationship of subgrades to traffic and road surfaces.

President H. L. Bowlby appointed a committee to work out a plan of co-ordinating the location and dates for the next conventions of the American Road Builders' Association, The Associated General Contractors of America, the American Society of Civil Engineers, and the American Association of State Highway Officials. This committee consists of C. M. Upham, State Highway Engineer for North Carolina and Secretary of the American Association of State Highway Officials; W. D. Uhler, of the Pennsylvania State Highway Department, and Gen. R. C. Marshall, Washington, D. C., representing the Associated General Contractors.

Cleveland Show Again Postponed

Postponement of the opening date of The American Building Exposition, Cleveland, from February 22 to a date in April, probably not later than the 18th, is announced by reason of the insistence of Mayor Kohler that the new city auditorium be complete to the last detail before it is formally accepted by the city and offered for exhibition purposes. The Exposition is to be the first public attraction in the new building.

This is the second postponement that has been forced upon the Exposition management through failure to have the building finished upon schedule time. Originally it was scheduled to open on January 4. This uncertainty about the building's completion has worked a considerable hardship, but with the date now fairly definitely fixed, the management expects speedily to close out the remaining unsold space, approximately $15,000 worth of an aggregate of $100,000.